United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
North Dakota Agricultural
Experiment Station, North
Dakota Cooperative
Extension Service, and
North Dakota State Soil
Conservation Committee

Soil Survey of Dickey County, North Dakota

How To Use This Soil Survey

General Soil Map

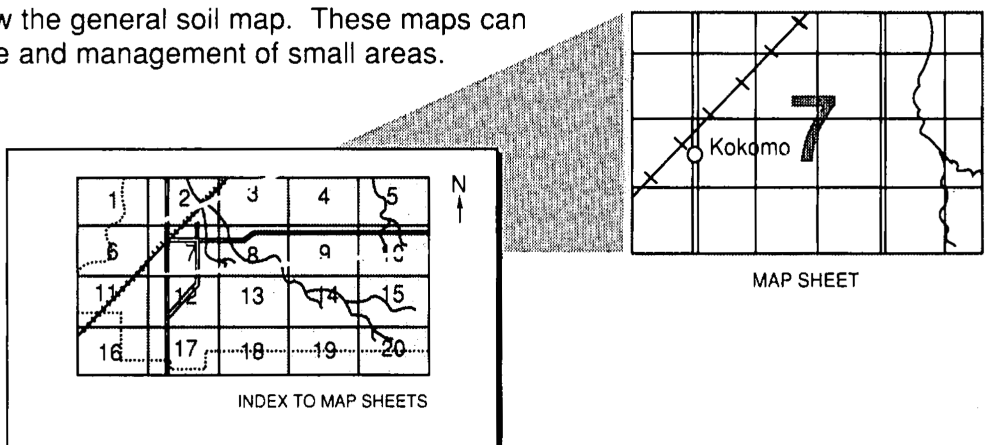
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

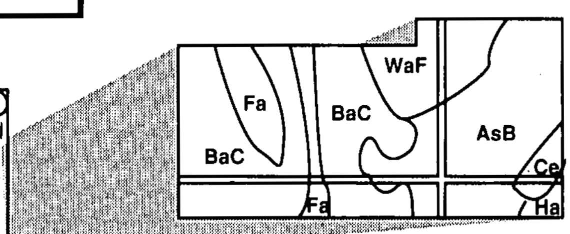
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.

MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1989. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. The flight for the photobase maps was in 1978. This survey was made cooperatively by the Soil Conservation Service and the North Dakota Agricultural Experiment Station, the North Dakota State Soil Conservation Committee, and the North Dakota Cooperative Extension Service. It is part of the technical assistance furnished to the James River Soil Conservation District. Financial assistance was provided by the James River Soil Conservation District, the Dickey County Water Resource Board, the North Dakota Department of University and School Lands, and the Dickey County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of the Barnes-Svea-Hamerly association. The multirow farmstead windbreaks provide protection from winter winds. The Parnell and Southam soils in the depressions are used mainly as wildlife habitat.

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Issued May 1993

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Dickey County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Ronnie L. Clark
State Conservationist
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Soil Survey of
Dickey County, North Dakota

By Lawrence E. Edland and Robert W. Drew, Soil Conservation Service

Fieldwork by Lawrence E. Edland, Robert W. Drew, Richard L. Lee, Renee Jacobson, David J. Breker, Alan Peer, Paul Finnell, Ramiro Melina, and John Hemple, Soil Conservation Service, and Wilhelm Soil Consulting, Inc., Stoneman and Landers, Inc., and Wesley Larsen, professional soil classifiers

Map finishing by David W. Hickcox and Steven S. Kranich, North Dakota State Soil Conservation Committee

United States Department of Agriculture, Soil Conservation Service,
in cooperation with North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, and North Dakota State Soil Conservation Committee

DICKEY COUNTY is in the southeastern part of North Dakota (fig. 1). It has a total area of 729,700 acres, of which 725,900 acres is land and 3,800 acres is water. The county is bounded on the south by South Dakota, on the east by Sargent County, on the north by Ransom and La Moure Counties, and on the west by McIntosh County. Ellendale, the county seat, is in the south-central part of the county.

The first soil survey of Dickey County was published in 1916 *(12)*. A general soil map of Dickey County was published in 1963 and described in a report published in 1968 *(11)*. The county also was included in a general soil map and report published in 1968 *(10)*. The present soil survey updates the earlier reports. It provides additional information and larger scale maps, which show the soils in more detail.

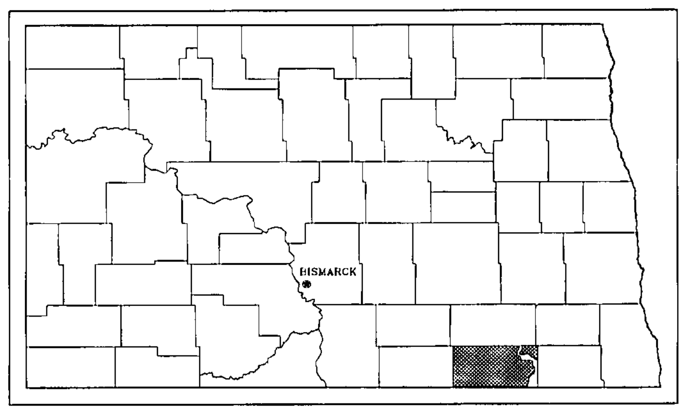

Figure 1.—Location of Dickey County in North Dakota.

General Nature of the County

This section provides general information about Dickey County. It describes climate; physiography, relief, and drainage; history and development; farming; and natural resources.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Dickey County is usually quite warm in summer with frequent spells of hot weather and occasional cool days. It is very cold in winter, when arctic air frequently surges over the area. Precipitation occurs mostly during the warm period and is normally heaviest in late spring and early summer. Winter snowfall is generally not heavy, and it is blown into drifts so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Ellendale in the period 1951 to 1986. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 14 degrees F and the average daily minimum temperature is 3 degrees. The lowest temperature on record, which occurred at Ellendale on January 15, 1972, is -37 degrees. In summer, the average temperature is 69 degrees and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred at Ellendale on July 11, 1973, is 108 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 20 inches. Of this, about 16 inches, or 80 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 12 inches. The heaviest 1-day rainfall during the period of record was 4.86 inches at Ellendale on May 27, 1963. Thunderstorms occur on about 32 days each year.

The average seasonal snowfall is about 32 inches. The greatest snow depth at any one time during the period of record was 33 inches. On the average, 36 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 14 miles per hour, in spring.

Several times each winter, storms with snow and high wind bring blizzard conditions to the area. Hail falls in small scattered areas during summer thunderstorms.

Physiography, Relief, and Drainage

The county, for the most part, is in the Drift Prairie district of the Central Lowland province. The western part of the county is in the Coteau du Missouri district of the Great Plains province. Local relief in the Coteau commonly is more than 50 feet *(3)*. The elevation in the county ranges from 2,240 feet in the southwest corner to 1,286 feet in the southeast corner along the James River. The southeastern portion of the county is the north end of Glacial Lake Dakota. The Elm, James, and Maple Rivers and Bear Creek flow through the county in a general north-to-south direction (fig. 2). Among the prominent landmarks in the county are Whitestone Battlefield and Johnsons Gulch. The county is part of the Central Dark Brown Glaciated Plains and the Central Black Glaciated Plains land resource area of the Northern Great Plains *(16)*.

History and Development

Indian tribes were the first people to occupy what is now Dickey County. The Yanktons, a branch of the Sioux people, roamed over the hills and prairies between the James and Missouri Rivers *(7)*.

The first recorded expedition into Dickey County was in 1839. The mission of this expedition was to explore the tributaries of the upper Mississippi basin. This party entered what is now Dickey County along the banks of the James River on July 17, 1839 *(7)*. In the summer of 1863, General Alfred Sully led an expedition against the Sioux through North Dakota, which resulted in the Battle of Whitestone Hill on September 3, 1863. This battle was the last confrontation between the Indians and soldiers east of the Missouri River.

By 1870, the township and range lines were established through Dickey County, but the area was yet to see any settlement.

The first attempt at any organization of the region in which Dickey County lies was made when the territory of Minnesota moved to include that part of the territory east of the Missouri and White Earth Rivers. On March 7, 1881, Dickey County was created by an act of the Territorial Legislature. At the time the new county was created, there were no settlers within the borders, but the Chicago, Milwaukee, and St. Paul Railways had laid about seven miles of track into the territory.

In the fall of 1881, four men filed claims on the four quarters known as the "Center of Ellendale." This became a major distribution point for settlers' supplies, lumber, and groceries *(7)*.

Because of the great influx of settlers, Governor Ordway appointed the first county commissioners. Ellendale was voted the county seat on November 7, 1882.

According to the Bureau of the Census, the population of Dickey County in 1890 was 5,573. It reached an all-time high of 10,877 by 1930 and then began a decline because of drought and the Great Depression. In 1980, the population was 7,207 *(9)*. Oakes, the largest town in the county, had a population of 2,112 in 1987. Other communities include Ellendale, Forbes, Guelph, Monango, Fullerton, Ludden, and Merricourt.

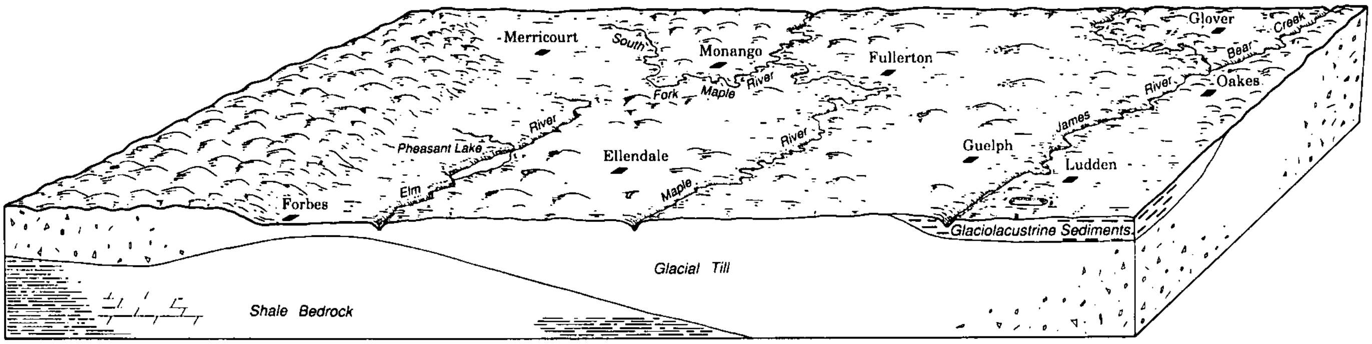

Figure 2.—Physiographic features of Dickey County.

Farming

Farming is the main economic enterprise in the county. The number of farms increased steadily from the 1800's to the 1930's, and then the number began to decline. In 1900, there were 933 farms with an average size of 268 acres. In 1935, there were 1,432 farms that averaged 451 acres. This number then declined to its present level of 611 farms that average 1,088 acres *(17)*. The James River Soil Conservation District was organized on February 17, 1947.

The principal crop is spring wheat. Other small grains, corn, sunflowers, millet, grass-legume hay, and flax are also grown.

About 73 percent of the county is cropland or pasture, and 19 percent is range. About 8 percent is used for other purposes. Livestock is raised primarily in the western quarter of the county in the more sloping areas.

Natural Resources

Soil is the most important natural resource in the county. It provides a growing medium for crops and for the grasses grazed by livestock. Other important resources are sand, gravel, and water.

As a result of glaciation, the county has numerous deposits of sandy and gravelly material suitable for commercial use. These deposits are in areas that overlie large aquifers.

The major aquifers are the Spiritwood, Nortonville, Ellendale, Guelph, Oakes, La Moure, and Edgeley aquifers *(3)*. These aquifers range in depth from 0 to 300 feet below the surface. The permeable deposits contain enough water to yield from 500 to as much as 1,500 gallons per minute. The yields and quality of water from these deposits are sufficient for ordinary farm and domestic uses and in many places are adequate for irrigation.

The extent of irrigation grew from 2 farms irrigating 41 acres in 1950 to 40 farms irrigating about 13,500 acres in 1982. Although some irrigation is in the glacial drift areas, most is south of Oakes on Glacial Lake Dakota. This area is part of the Garrison Diversion Irrigation Project.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however,

soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but

onsite investigation is needed to plan for intensive uses in small areas.

Survey Procedures

The general procedures used to make this survey are described in the "National Soils Handbook" and the "Soil Survey Manual" *(13)*. "The Major Soils of North Dakota" *(12)*, "Soil Taxonomy" *(15)*, and "Land Resource Regions and Major Land Resource Areas of the United States" *(16)* were among the references used. The procedures used in determining the nature and characteristics of the soils are described under the heading "How This Survey Was Made."

Soil scientists traversed the land on foot and by pickup at an interval close enough for them to locate contrasting soil areas of about 3 to 5 acres. All map units were characterized by transects of representative areas. Generally, one transect was recorded for each 1,000 acres of a given map unit.

Data collected from the transects were used to determine soil names and establish the range of composition of each map unit. The statistical method described by R.W. Arnold was used *(4)*. This statistical analysis indicates that the map unit composition given in the map unit descriptions is at least 90 percent accurate. Because of a small acreage, the composition of map units 2 and 3 was estimated from a limited number of transects and from field observations. Map unit 50 has a wider range of composition than most other map units.

Each soil map unit was documented by at least one pedon description for each soil series identified in its name. Laboratory data were collected in 1980 and 1981 on 12 pedons sampled for engineering properties. The analyses were made by the North Dakota State Highway Department. Nine of the pedons collected for analysis of engineering properties were analyzed by the North Dakota State University Soil Characterization Laboratory.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

As a result of changes in series concepts, the location of moisture regime areas, differing soil patterns, and differences in the design of the associations, some of the soil boundaries and soil names on the general soil map of this survey area do not match those on the maps of La Moure and Sargent Counties, North Dakota, and Brown and McPherson Counties, South Dakota.

Soil Descriptions

Dominantly Level to Hilly, Loamy Soils on Till Plains, Moraines, and Outwash Plains

These soils formed in glacial till, alluvium, eolian material, glaciofluvial deposits, and material weathered from shale bedrock. They make up about 71 percent of the county. Most areas are used for cultivated crops, but some areas are used for range. The soils are suited to cultivated crops and range. The main concern in managing cultivated areas is controlling soil blowing and water erosion. The main concerns in managing range are achieving proper grazing use and maintaining an adequate cover of the important range forage plants.

1. Barnes-Svea-Hamerly Association

Deep, level to hilly, well drained to somewhat poorly drained, medium textured soils

This association consists of level to hilly soils on summits, side slopes, and foot slopes on till plains and moraines. Slopes are short and complex. The landscape is dotted with knolls, ridges, flats, and depressions. Runoff flows mostly to the depressions, but some flows to streams. Slope ranges from 0 to 25 percent.

This association makes up about 44 percent of the county. It is about 36 percent Barnes soils, 21 percent Svea soils, 10 percent Hamerly soils, and 33 percent soils of minor extent (fig. 3).

The nearly level to hilly, well drained Barnes soils are on summits and side slopes. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

The level to undulating, moderately well drained Svea soils are on the upper foot slopes. Typically, the surface layer is black loam about 8 inches thick. The subsoil is about 29 inches thick. In sequence downward, it is very dark gray loam, very dark grayish brown loam, dark grayish brown loam, and light olive brown, mottled clay loam. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam.

The level and nearly level, somewhat poorly drained Hamerly soils are on the lower foot slopes surrounding depressions. Typically, the surface layer is black loam about 7 inches thick. The subsoil is light olive brown loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, mottled loam.

Buse, Cresbard, Parnell, and Tonka soils are the principal minor soils in this association. The Buse soils are on ridges and knolls. They are well drained and have a subsoil that is calcareous throughout. The sodic

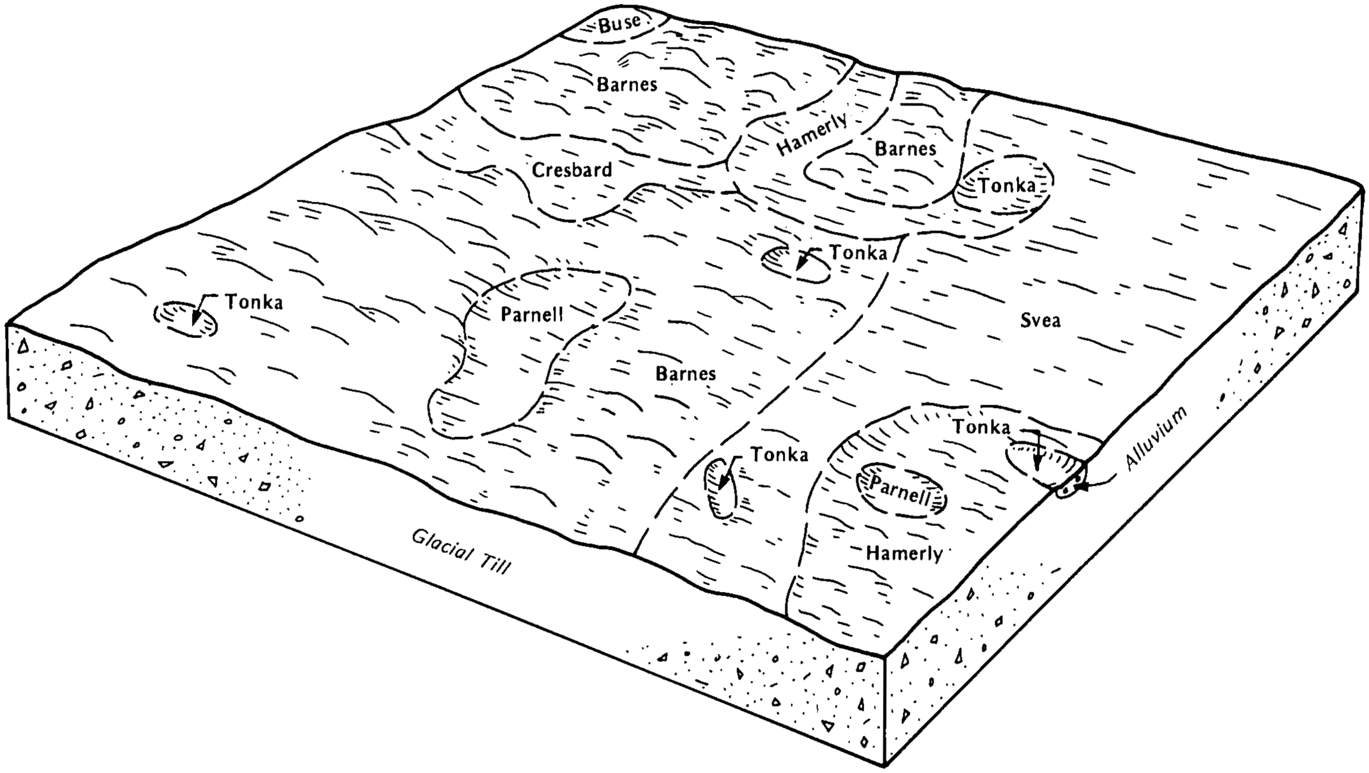

Figure 3.—Typical pattern of soils and parent material in the Barnes-Svea-Hamerly association.

Cresbard soils are on flats. They are moderately well drained and have accumulated clay in the subsoil. The Parnell soils are in deep depressions. They have a surface layer of silty clay loam and have accumulated clay in the subsoil. The Tonka soils are in shallow depressions. They have a leached subsurface layer and have accumulated clay in the subsoil.

Most areas of this association are used for cultivated crops. The soils are suited to small grain, corn, and sunflowers and to range and pasture. The main concerns in managing cultivated areas are controlling water erosion and soil blowing and overcoming the wetness of the included Parnell and Tonka soils.

2. Swenoda-Barnes-Letcher Association

Deep, level and nearly level, well drained to somewhat poorly drained, moderately coarse textured and medium textured soils

This association consists of level and nearly level soils on summits, side slopes, rises, and swells and in swales on till plains. The landscape is dotted by depressions, swales, and flats. Runoff flows to the depressions. Slope ranges from 0 to 3 percent.

This association makes up about 4 percent of the county. It is about 43 percent Swenoda soils, 15 percent Barnes soils, 9 percent Letcher and similar soils, and 33 percent soils of minor extent.

The nearly level, moderately well drained Swenoda soils are on swells and rises. Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 22 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is loam. It is grayish brown in the upper part and light brownish gray and mottled in the lower part.

The nearly level, well drained Barnes soils are on summits and side slopes. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

The level and nearly level, somewhat poorly drained, sodic Letcher soils are in swales. Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsurface layer is very dark gray, mottled sandy loam about 1 inch thick. The subsoil is about 33 inches thick. In sequence downward, it is dense, dark brown, mottled

sandy loam; dark grayish brown, mottled sandy loam; grayish brown loam; and olive gray loam. The substratum to a depth of about 60 inches is olive brown, mottled fine sandy loam.

Hamerly, Kratka, Parnell, and Tiffany soils are the principal minor soils in this association. The Hamerly soils are on flats and on the rims of depressions. They are somewhat poorly drained and have an accumulation of lime within a depth of 16 inches. The Kratka soils are in depressions. They are poorly drained and have a surface layer of fine sandy loam. The Parnell soils are in deep depressions. They are very poorly drained and have accumulated clay in the subsoil. The Tiffany soils are in shallow depressions and swales. They are poorly drained and have a surface layer of fine sandy loam.

Most areas of this association are used for cultivated crops. The soils are suited to small grain and sunflowers and to range and pasture. The main concerns in managing cultivated areas are controlling water erosion and soil blowing and improving root penetration in the dense, sodic subsoil of the Letcher soils.

3. Barnes-Cresbard-Hamerly Association

Deep, level to undulating, well drained to somewhat poorly drained, medium textured soils

This association consists of level to undulating soils on rises and flats and in swales on till plains. The landscape is dotted by ridges, knolls, and depressions. Runoff flows to the depressions. Slope ranges from 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 31 percent Barnes soils, 27 percent Cresbard soils, 13 percent Hamerly soils, and 29 percent soils of minor extent.

The nearly level to undulating, well drained Barnes soils are on rises. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

The level to undulating, moderately well drained, sodic Cresbard soils are in swales. Typically, the surface layer is loam about 9 inches thick. It is black in the upper part and very dark gray in the lower part. The next layer is about 3 inches thick. It is black loam that has dark grayish brown silt coatings. The subsoil is dense clay loam about 22 inches thick. It is very dark grayish brown in the upper part, dark grayish brown in the next part, and light olive brown and mottled in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam.

The level and nearly level, somewhat poorly drained Hamerly soils are on flats and on the rims of depressions. Typically, the surface layer is black loam about 7 inches thick. The subsoil is light olive brown loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, mottled loam.

Buse, Parnell, and Tonka soils are the principal minor soils in this association. The Buse soils are on ridges and knolls. They are well drained and have a subsoil that is calcareous throughout. The Parnell soils are in deep depressions. They are very poorly drained and have accumulated clay in the subsoil. The Tonka soils are poorly drained and are in shallow depressions. They have a leached subsurface layer and accumulated clay in the subsoil.

Most areas of this association are used for cultivated crops. The soils are suited to small grain and sunflowers and to range and pasture. The main concerns in managing cultivated areas are controlling water erosion and soil blowing and improving root penetration in the dense, sodic subsoil of the Cresbard soils.

4. Cavour-Barnes Association

Deep, level to undulating, well drained, medium textured soils

This association consists of level to undulating soils on swells and in swales on till plains. The landscape is dotted by knolls, ridges, depressions, drainageways, and flats adjacent to depressions. Runoff flows to the depressions. Slope ranges from 0 to 6 percent.

This association makes up about 14 percent of the county. It is about 33 percent Cavour soils, 29 percent Barnes soils, and 38 percent soils of minor extent (fig. 4).

The nearly level and undulating, well drained, sodic Cavour soils are in swales. Typically, the surface layer is loam about 9 inches thick. It is black in the upper part and very dark grayish brown in the lower part. The subsurface layer is dark gray loam about 3 inches thick. The subsoil is about 19 inches thick. It is dense. It is very dark brown clay in the upper part, very dark grayish brown clay loam in the next part, and olive brown clay loam in the lower part. The substratum to a depth of about 60 inches is grayish brown loam.

The level to undulating, well drained Barnes soils are on swells. Typically, the surface layer is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Buse, Hamerly, Harriet, Miranda, Renshaw, and Tonka soils are the principal minor soils in this

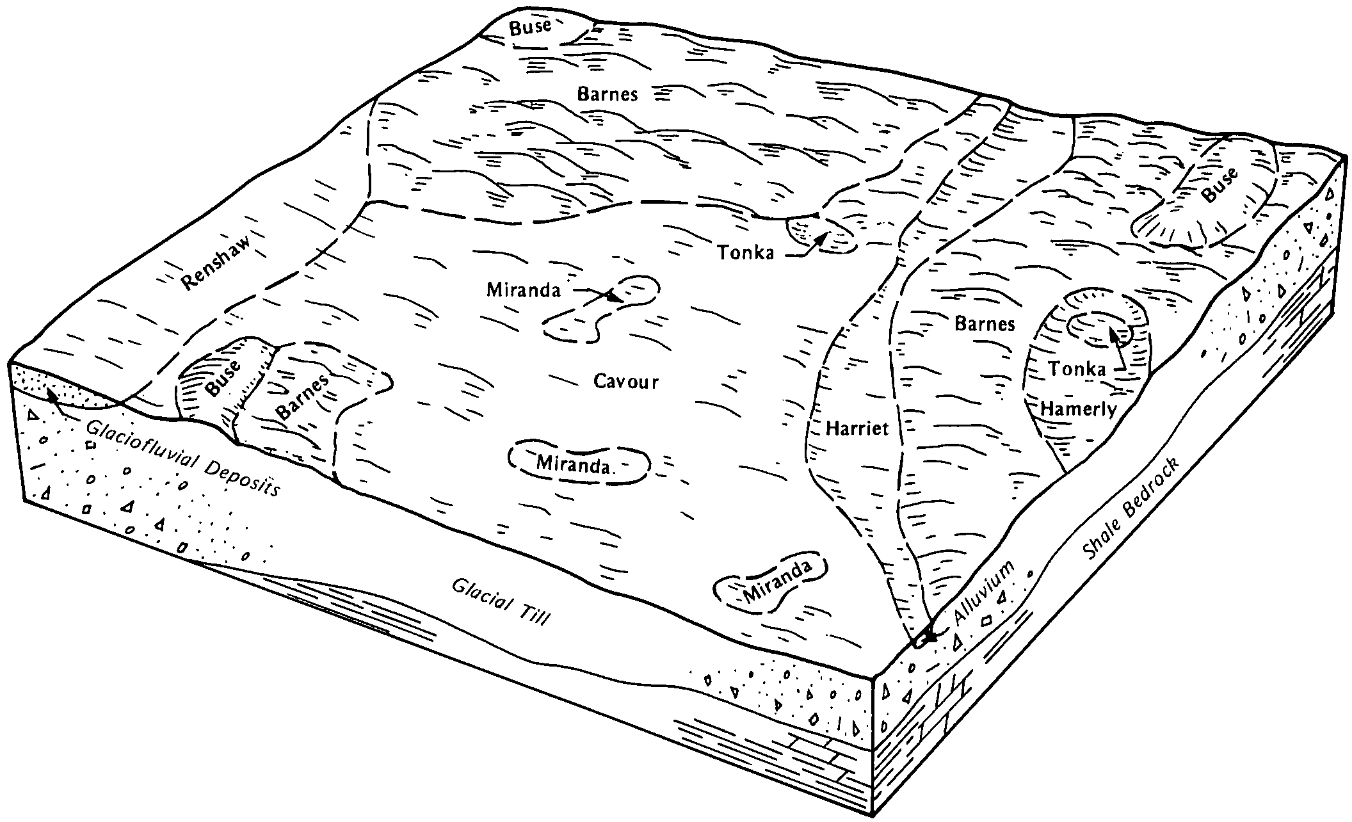

Figure 4.—Typical pattern of soils and parent material in the Cavour-Barnes association.

association. The Buse soils are on ridges and knolls. They are well drained and have a subsoil that is calcareous throughout. The Hamerly soils are on flats. They are somewhat poorly drained and have accumulated lime within a depth of 16 inches. The Harriet soils are in drainageways. They are poorly drained, sodic, and saline. The Miranda and Renshaw soils are on flats. The Miranda soils have a dense, sodic subsoil. The Renshaw soils are somewhat excessively drained and have a gravelly substratum. The poorly drained Tonka soils are in shallow depressions. They have a subsurface layer and have accumulated clay in the subsoil.

Most areas of this association are used for cultivated crops. The soils are suited to small grain and sunflowers and to range and pasture. The main concerns in managing cultivated areas are controlling water erosion and improving root penetration in the dense subsoil of the Cavour soils.

5. Edgeley-Brantford-Cavour Association

Moderately deep and deep, nearly level and undulating, well drained, medium textured soils

This association consists of nearly level and undulating soils on ridges, swells, and flats and in swales on till plains and outwash plains. Slope ranges from 1 to 6 percent.

This association makes up about 4 percent of the county. It is about 26 percent Edgeley soils, 18 percent Brantford and similar soils, 16 percent Cavour and similar soils, and 40 percent soils of minor extent.

The nearly level and undulating, well drained, moderately deep Edgeley soils are on flats and in swales. Typically, the surface layer is black loam about 6 inches thick. The next layer is very dark brown loam about 9 inches thick. The subsoil is dark brown loam about 11 inches thick. The substratum to a depth of about 34 inches is dark brown channery loam. Below

this is very dark grayish brown shale bedrock.

The nearly level, well drained, deep Brantford soils are on flats, swells, and ridges. Typically, the surface layer is black loam about 8 inches thick. The subsoil is very dark grayish brown loam about 7 inches thick. The upper part of the substratum is dark grayish brown gravelly sand. The lower part to a depth of about 60 inches is dark brown and pale brown very gravelly coarse sand.

The nearly level and undulating, well drained, deep, sodic Cavour soils are in swales. Typically, the surface layer is loam about 9 inches thick. It is black in the upper part and very dark gray in the lower part. The subsurface layer is dark gray loam about 3 inches thick. The subsoil is dense clay loam about 19 inches thick. It is very dark brown in the upper part, very dark grayish brown in the next part, and olive brown in the lower part. The substratum to a depth of about 60 inches is grayish brown loam.

Barnes, Buse, and Svea soils are the principal minor soils in this association. The Barnes soils are on swells. They are well drained and are calcareous in the lower part of the subsoil. The Buse soils are on knolls and ridges. They are well drained and have a subsoil that is calcareous throughout. The Svea soils are in swales. They are moderately well drained and have a surface layer that is dark to a depth of 16 inches or more.

Most areas of this association are used for cultivated crops. The soils are suited to small grain and sunflowers and to range and pasture. The main concerns in managing cultivated areas are controlling water erosion, overcoming droughtiness in the Brantford and Cavour soils, and improving root penetration in the dense, sodic subsoil of the Cavour soils.

Dominantly Nearly Level to Very Steep, Loamy Soils on Outwash Plains, Till Plains, and Moraines

These soils formed in glaciofluvial deposits, glacial till, and alluvium. They make up about 13 percent of the county. Large areas are used for range, but some areas are used for cultivated crops. The soils are well suited to range, and the level to rolling areas are suited to cultivated crops. The main concerns in managing range are achieving proper grazing use and maintaining an adequate cover of the important range forage plants. The main concern in managing cultivated areas is controlling water erosion.

6. Wabek-Lehr-Zahl Association

Deep, nearly level to hilly, excessively drained to well drained, medium textured soils

This association consists of nearly level to hilly soils on flats, rises, knolls, and ridges on outwash plains, moraines, and till plains. Slope ranges from 1 to 25 percent.

This association makes up about 2 percent of the county. It is about 35 percent Wabek soils, 26 percent Lehr and similar soils, 10 percent Zahl soils, and 29 percent soils of minor extent.

The nearly level to hilly, excessively drained Wabek soils are on knolls and ridges. Typically, the surface layer is very dark brown loam about 6 inches thick. The upper part of the substratum is dark grayish brown gravelly coarse sand. The lower part to a depth of about 60 inches is dark yellowish brown very gravelly coarse sand.

The nearly level and undulating, somewhat excessively drained Lehr soils are on flats and rises. Typically, the surface layer is very dark brown loam about 9 inches thick. The subsoil is loam about 8 inches thick. It is dark brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is dark grayish brown gravelly coarse sand.

The undulating to hilly, well drained Zahl soils are on ridges. Typically, the surface layer is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam.

Southam, Vallers, and Williams soils are the principal minor soils in this association. Also included in this association are areas of open water more than 40 acres in size. The Southam soils are in deep depressions. They are very poorly drained and are highly calcareous. The Vallers soils are in swales. They are poorly drained and are highly calcareous. The Williams soils are on side slopes. They are well drained and have accumulated clay in the subsoil.

Most areas are used for range or pasture, but some of the less sloping areas are used for cultivated crops. The main concerns in managing cultivated areas are controlling soil blowing and water erosion and overcoming droughtiness. The main concerns in managing pasture and range are maintaining an adequate cover of the important range forage plants or suitable pasture plants and achieving a uniform distribution of grazing.

7. Williams-Bowbells-Zahl Association

Deep, nearly level to very steep, well drained and moderately well drained, medium textured soils

This association consists of nearly level to very steep soils on ridges, summits, shoulder slopes, side slopes, and foot slopes on till plains and moraines. Slopes are short and complex. The landscape is dotted with flats and depressions. Runoff flows mostly to the

depressions, but some flows to streams. Slope ranges from 1 to 45 percent.

This association makes up about 5 percent of the county. It is about 41 percent Williams soils, 27 percent Bowbells soils, 18 percent Zahl soils, and 14 percent soils of minor extent (fig. 5).

The nearly level to hilly, well drained Williams soils are on side slopes and summits. Typically, the surface layer is very dark brown loam about 7 inches thick. The subsoil is about 27 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

The undulating, moderately well drained Bowbells soils are on foot slopes. Typically, the surface layer is black loam about 6 inches thick. The subsoil is about 27 inches thick. It is very dark brown clay loam in the upper part, very dark grayish brown clay loam in the next part, and light yellowish brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

The undulating to very steep, well drained Zahl soils are on ridges and shoulder slopes. Typically, the surface layer is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam.

Lehr, Parnell, Southam, and Wabek soils are the principal minor soils in this association. The Lehr soils are on flats and side slopes. They are somewhat excessively drained and have a gravelly substratum. The very poorly drained Parnell and Southam soils are in deep depressions. The Parnell soils have accumulated clay in the subsoil. The Southam soils have carbonates within a depth of 10 inches. The Wabek soils are excessively drained and have a gravelly substratum.

Most areas of this association are used for range, pasture, or cultivated crops. The soils are suited to small grain, corn, and sunflowers and to range and pasture. The main concern in managing cultivated areas is controlling water erosion and soil blowing. The main concerns in managing range or pasture are achieving proper grazing use and maintaining an adequate cover of the important range forage plants or suitable pasture plants.

8. Zahl-Williams Association

Deep, nearly level to very steep, well drained, medium textured soils

This association consists of nearly level to very steep soils on ridges, summits, shoulder slopes, and side slopes on till plains and moraines. Slopes are short and complex. The landscape is dotted with flats and depressions. Runoff flows mostly to the depressions, but some flows to streams. Slope ranges from 1 to 45 percent.

This association makes up about 6 percent of the county. It is about 38 percent Zahl soils, 35 percent Williams soils, and 27 percent soils of minor extent.

The undulating to very steep, well drained Zahl soils are on ridges and shoulder slopes. Typically, the surface layer is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam.

The nearly level to hilly, well drained Williams soils are on side slopes and summits. Typically, the surface layer is very dark brown loam about 7 inches thick. The subsoil is about 27 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Bowbells, Parnell, and Wabek soils are the principal minor soils in this association. The Bowbells soils are in swales. They have a surface layer that is dark to a depth of 16 inches or more. The Parnell soils are in deep depressions. They are very poorly drained and have accumulated clay in the subsoil. The Wabek soils are on knolls and ridges. They are excessively drained and have a gravelly substratum.

Most areas of this association are used for pasture or range, but the less sloping areas are used for cultivated crops. The soils are poorly suited to small grain, corn, and sunflowers but are well suited to range and pasture. The main concern in managing cultivated areas is controlling water erosion and soil blowing. The main concerns in managing range or pasture are achieving proper grazing use and maintaining an adequate cover of the important range forage plants or suitable pasture plants.

Dominantly Level to Rolling, Sandy, Silty, and Loamy Soils on Outwash Plains and Lake Plains

These soils formed in glaciolacustrine sediments, glaciofluvial deposits, and eolian material. They make up about 11 percent of the county. Most areas are used for cultivated crops, but some areas are used for range. The soils are suited to cultivated crops and range. The main concerns in managing cultivated areas are controlling soil blowing, overcoming droughtiness, and conserving moisture. The main concerns in managing range are maintaining an adequate cover of the important range forage plants and achieving proper grazing use.

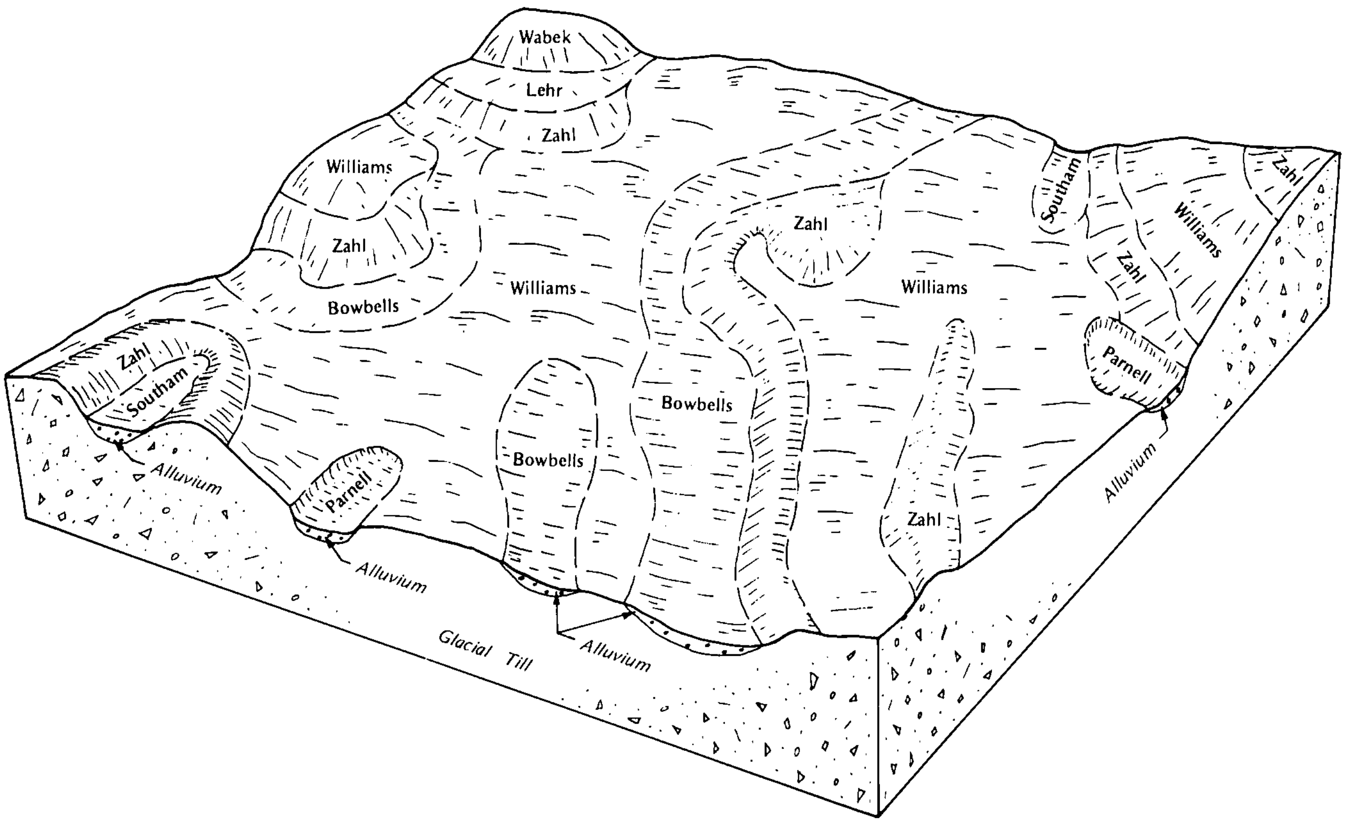

Figure 5.—Typical pattern of soils and parent material in the Williams-Bowbells-Zahl association.

9. Hecla-Ulen-Hamar Association

Deep, level and nearly level, moderately well drained to poorly drained, coarse textured and moderately coarse textured soils

This association consists of level and nearly level soils on rises and flats and in swales and depressions on lake plains. Slopes generally are short and choppy. They range from 0 to 3 percent.

This association makes up about 6 percent of the county. It is about 30 percent Hecla soils, 24 percent Ulen soils, 11 percent Hamar soils, and 35 percent soils of minor extent.

The level and nearly level, moderately well drained Hecla soils are on flats and rises. Typically, the surface soil is loamy fine sand about 20 inches thick. It is black in the upper part and very dark gray in the lower part. The next layer is very dark grayish brown, mottled fine sand about 12 inches thick. Below this is very dark gray loamy fine sand about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled fine sand.

The level, somewhat poorly drained Ulen soils are in swales and on flats. Typically, the surface soil is black fine sandy loam about 12 inches thick. The upper part of the subsoil is dark grayish brown and light brownish gray fine sandy loam about 4 inches thick. The next part is very dark grayish brown, mottled fine sandy loam about 4 inches thick. The lower part is light olive gray, mottled loamy fine sand about 16 inches thick. The substratum to a depth of about 60 inches is fine sand. It is olive gray in the upper part and dark grayish brown in the lower part.

The level and nearly level, poorly drained Hamar soils are in swales and depressions. Typically, the surface soil is loamy fine sand about 12 inches thick. It is black in the upper part and very dark brown and mottled in the lower part. The substratum to a depth of about 60 inches is mottled fine sand. It is light brownish gray in the upper part and olive gray in the lower part.

Colvin, Glyndon, Maddock, and Stirum soils are the principal minor soils in this association. The very poorly drained Colvin soils are on flats and in shallow depressions. They are highly calcareous. The somewhat poorly drained Glyndon soils are on flats. They have more clay in the subsoil than the major soils.

The Maddock soils are on low ridges. They are well drained. The poorly drained Stirum soils are in depressions. They are sodic and saline.

Most areas of this association are used for cultivated crops. The soils are poorly suited to cultivated crops but are well suited to hay, range, and pasture. The main concerns in managing cultivated areas are controlling soil blowing and overcoming droughtiness. The main concerns in managing range and pasture are achieving proper grazing use and maintaining an adequate cover of the important range forage plants or suitable pasture plants.

10. Gardena-Glyndon-Overly Association

Deep, level to undulating, moderately well drained and somewhat poorly drained, medium textured soils

This association consists of level to undulating soils on flats and swells and in swales on lake plains. A few depressions are scattered throughout most areas. Runoff flows to the depressions and to shallow drainageways. Slope ranges from 0 to 6 percent.

This association makes up about 2 percent of the county. It is about 39 percent Gardena soils, 24 percent Glyndon soils, 13 percent Overly soils, and 24 percent soils of minor extent.

The level to undulating, moderately well drained Gardena soils are on swells. Typically, the surface soil is black loam or silt loam about 12 inches thick. The subsoil is loam about 26 inches thick. It is very dark grayish brown in the upper part and light olive brown in the lower part. The substratum to a depth of about 60 inches is very fine sandy loam. It is mottled. It is light olive brown in the upper part, olive gray in the next part, and light olive brown in the lower part.

The level and nearly level, somewhat poorly drained Glyndon soils are on flats and in swales. Typically, the surface layer is black silt loam about 9 inches thick. The subsoil is light brownish gray silt loam about 12 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is light brownish gray, mottled very fine sandy loam.

The level, moderately well drained Overly soils are on swells. Typically, the surface layer is black. It is about 13 inches thick. It is silt loam in the upper part and silty clay loam in the lower part. The subsoil is silt loam about 29 inches thick. It is very dark grayish brown and mottled in the upper part, grayish brown and mottled in the next part, and light brownish gray in the lower part. The substratum to a depth of about 60 inches is olive yellow, mottled silt loam.

Aberdeen, Stirum, and Tonka soils are the principal minor soils in this association. The Aberdeen soils are on flats. They are moderately well drained and have a dense, sodic subsoil. The poorly drained Stirum and Tonka soils are in shallow depressions. The Stirum soils are sodic and saline. The Tonka soils have a leached subsurface layer and have accumulated clay in the subsoil.

Most areas of this association are used for cultivated crops. The soils are well suited to small grain, corn, and sunflowers and to range and pasture. The main concern in managing cultivated areas is controlling water erosion and soil blowing. The main concerns in managing range or pasture are achieving proper grazing use and maintaining an adequate cover of the important range forage plants or suitable pasture plants.

11. Spottswood-Renshaw-Sioux Association

Deep, level to rolling, moderately well drained, somewhat excessively drained, and excessively drained, medium textured soils

This association consists of level to rolling soils on flats, swells, side slopes, knolls, and ridges on outwash plains. Slope ranges from 0 to 15 percent.

This association makes up about 3 percent of the county. It is about 31 percent Spottswood and similar soils, 22 percent Renshaw and similar soils, 15 percent Sioux soils, and 32 percent soils of minor extent.

The nearly level, moderately well drained Spottswood soils are on flats. Typically, the surface layer is black loam about 9 inches thick. The subsoil is about 25 inches thick. In sequence downward, it is very dark gray clay loam; black clay loam; grayish brown, mottled loam; and light olive brown, mottled gravelly loam. The substratum to a depth of about 60 inches is light olive brown, mottled very gravelly coarse sand.

The level to undulating, somewhat excessively drained Renshaw soils are on flats, swells, and side slopes of ridges and knolls. Typically, the surface layer is black loam about 8 inches thick. The subsoil is very dark grayish brown loam about 8 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown gravelly loamy sand.

The nearly level to rolling, excessively drained Sioux soils are on ridges and knolls. Typically, the surface layer is black loam about 8 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown gravelly coarse sand.

Cavour, Forman, and Hamerly soils are the principal minor soils in this association. The Cavour soils are in swales. They are well drained and have a dense, sodic subsoil. The Forman soils are on rises. They are well drained and have a loamy subsoil. The Hamerly soils are on flats. They are somewhat poorly drained and have an accumulation of lime within a depth of 16 inches.

Most areas of this association are used for cultivated crops, but some areas are used for hay or pasture. The Spottswood and Renshaw soils are suited to small grain, corn, pasture, and hay. The Sioux soils are best suited to hay, pasture, and range. The main concerns in managing cultivated areas are controlling soil blowing and overcoming droughtiness. The main concern in managing for hay, range, or pasture is maintaining an adequate cover of the suitable hay and pasture plants or the important range forage plants.

Dominantly Level, Loamy and Clayey Soils on Flood Plains and Terraces

These soils formed in alluvium and glaciofluvial deposits. They make up about 5 percent of the county. Most areas are used for cultivated crops, but some areas are used for range. The soils are suited to cultivated crops and range. The main concerns in managing cultivated areas are overcoming wetness and controlling flooding and soil blowing. The main concerns in managing range are achieving proper grazing use and maintaining an adequate cover of the important range forage plants.

12. Lamoure-Ludden-Ryan Association

Deep, level, poorly drained, medium textured and fine textured soils

This association consists of level, poorly drained soils on flats and in swales on flood plains. Slope is 0 to 1 percent.

This association makes up about 2 percent of the county. It is about 24 percent Lamoure soils, 21 percent Ludden soils, 19 percent Ryan soils, and 36 percent soils of minor extent.

The Lamoure soils are on flats. Typically, the surface soil is very dark gray. It is about 34 inches thick. It is silt loam in the upper part and silty clay loam in the lower part. The next layer is black silty clay loam about 5 inches thick. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam.

The Ludden soils are on flats. Typically, the surface soil is black clay about 14 inches thick. The subsoil also is black clay. It is about 16 inches thick. The substratum to a depth of about 60 inches is very dark gray clay.

The Ryan soils are in swales. Typically, the surface layer is black silty clay about 2 inches thick. The subsoil also is black silty clay. It is about 34 inches thick. The substratum to a depth of about 60 inches is very dark gray silty clay.

Colvin, La Prairie, Southam, and Stirum soils are the principal minor soils in this association. The Colvin soils are on flats in drainage channels. They are very poorly drained and are calcareous throughout. The La Prairie soils are on rises. They are moderately well drained. The Southam soils are in depressions. They are very poorly drained and have a calcareous subsoil and substratum.

Most areas are used for cultivated crops. The soils are poorly suited to cultivated crops but are suited to hay, pasture, and range. The main concerns in managing cultivated areas are controlling soil blowing, improving tilth, improving root penetration in the subsoil of the Ryan soils, and overcoming the hazard of flooding. The main concern in managing pasture and range is maintaining an adequate cover of the suitable pasture plants or important range forage plants.

13. La Prairie-Renshaw Association

Deep, level, moderately well drained and somewhat excessively drained, medium textured soils

This association consists of level soils on flats on flood plains and terraces. Runoff flows mostly into streams. Slope is 0 to 1 percent.

This association makes up about 3 percent of the county. It is about 43 percent La Prairie soils, 24 percent Renshaw soils, and 33 percent soils of minor extent.

The moderately well drained La Prairie soils are on flats. Typically, the surface soil is black loam about 18 inches thick. The subsoil is very dark brown loam about 4 inches thick. The next layer is black silt loam about 7 inches thick. The substratum to a depth of about 60 inches is dark grayish brown loam.

The somewhat excessively drained Renshaw soils are on flats. Typically, the surface layer is black loam about 8 inches thick. The subsoil is very dark grayish brown loam about 7 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown gravelly loamy sand.

Buse and Cresbard soils are the principal minor soils in this association. The Buse soils are on ridges, shoulder slopes, and knolls. They are well drained and have a subsoil that is calcareous throughout. The Cresbard soils are in swales. They are moderately well drained and have a dense, sodic subsoil.

Most areas are used for pasture or range. Because of flooding, wetness, and meandering channels, the soils are poorly suited to cultivated crops. The main concern in managing pasture or range is maintaining an adequate cover of the important range forage plants or suitable pasture plants.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Colvin silt loam is a phase of the Colvin series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The map unit "Pits" is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

As a result of changes in series concepts, the location of moisture regime areas, differing soil patterns, and differences in the design of the map units, some of the soil boundaries and soil names on the detailed soil maps of this survey area do not match those on the maps of La Moure and Sargent Counties, North Dakota, and Brown and McPherson Counties, South Dakota.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

2—Overly-Aberdeen silt loams. These deep, level, moderately well drained soils are on broad flats on lake plains. Individual areas range from about 5 to more than 200 acres in size. They are about 65 to 75 percent Overly soil and 25 to 35 percent sodic Aberdeen soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Overly soil has a black surface soil about 13 inches thick. The upper part is silt loam, and the lower part is silty clay loam. The subsoil is silt loam about 29 inches thick. It is very dark grayish brown and mottled in the upper part, grayish brown and mottled in the next part, and light brownish gray in the lower part. The substratum to a depth of about 60 inches is olive yellow, mottled silt loam. In some places the substratum

has thin strata of fine sandy loam or loamy sand below a depth of 40 inches.

Typically, the surface layer of the Aberdeen soil is black silt loam about 9 inches thick. The next layer is very dark grayish brown loam about 4 inches thick. The subsoil is dense silty clay loam about 14 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled silt loam. In some places the subsoil is very dense.

Included with these soils in mapping are small areas of Eckman soils. These included soils make up about 5 to 10 percent of the unit. They do not have a sodic subsoil. They are on flats and rises.

Permeability is moderately slow in the Overly soil and slow in the Aberdeen soil. Runoff is slow on both soils. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet. Tilth is fair. The surface is hard and crusted when dry and dispersed when wet. The dense, sodic subsoil in the Aberdeen soil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, sunflowers, and flax and to grass-legume hay. The main concerns in managing cultivated areas are maintaining tilth and controlling erosion. Because of moisture stress in most years, crop growth on the Aberdeen soil is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts in the Aberdeen soil adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the Aberdeen soil. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, annual crop barriers, and a cropping sequence that includes grass-legume hay help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are green needlegrass, needlegrass, slender wheatgrass, and western wheatgrass. Smooth brome, alfalfa, and sweetclover are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants helps to control erosion.

The Overly soil is suited to all and the Aberdeen soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Individual trees and shrubs on the Aberdeen soil vary in height, density, and vigor. They are affected by the restricted root development in the subsoil and by the reduced amount of available water caused by the salts in the soils.

The land capability classification of the Overly soil is IIc, and that of the Aberdeen soil is IIIs. The productivity index of the unit for spring wheat is 86. The range site of the Overly soil is Silty, and that of the Aberdeen soil is Clayey.

3—Aberdeen-Exline silt loams. These deep, level soils are on lake plains. The moderately well drained, sodic Aberdeen soil is on flats and rises. The somewhat poorly drained, moderately saline, sodic Exline soil is on flats and in swales. Individual areas of this unit range from about 10 to more than 400 acres in size. They are about 55 to 65 percent Aberdeen soil and 30 to 40 percent Exline soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Aberdeen soil is black silt loam about 9 inches thick. The next layer is very dark grayish brown loam about 4 inches thick. The subsoil is dense silty clay loam about 14 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled silt loam.

Typically, the surface layer of the Exline soil is black silt loam about 8 inches thick. It has filaments of salts. The subsoil is about 17 inches thick. It is dense. In sequence downward, it is black silty clay, very dark brown silty clay loam, very dark gray silty clay loam, and dark grayish brown silty clay loam. The substratum to a depth of about 60 inches is silty clay loam. It is grayish brown in the upper part and light olive brown in the lower part. In places the surface layer is silty clay loam.

Included with these soils in mapping are small areas of the moderately well drained, nonsodic Overly soils on rises. These included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Aberdeen soil and very slow in the Exline soil. Runoff is slow on the Aberdeen soil and very slow on the Exline soil. Available water capacity and organic matter content are high in the Aberdeen soil and moderate in the Exline soil. A seasonal high water table is at a depth of 4.0 to 6.0 feet in the Aberdeen soil and at a depth of 2.5 to 4.0 feet in the Exline soil. Tilth is fair in both soils. The surface is hard and crusted when dry and dispersed when wet.

The dense, sodic subsoil in both soils restricts the depth to which roots can penetrate, and salts reduce the amount of water available to plants.

Most areas are used for cultivated crops. These soils are poorly suited to wheat, flax, and sunflowers but are suited to grass-legume hay. The main concerns in managing cultivated areas are maintaining or improving tilth and controlling erosion. Because of moisture stress in most years, crop growth is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts, particularly in the Exline soil, adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soils are neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the dense, sodic subsoil. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native plants are western wheatgrass and blue grama. Smooth brome, sweetclover, and alfalfa are suitable hay and pasture plants. The dense, sodic subsoil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important plants or of other suitable plants helps to prevent denuding. Stock water ponds constructed in areas of the Exline soil sometimes contain salty water.

The Aberdeen soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Exline soil generally is unsuited to these uses. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Supplemental watering or irrigation helps to ensure the survival of the seedlings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soils.

The land capability classification of the Aberdeen soil is IIIs, and that of the Exline soil is VIs. The productivity index of the unit for spring wheat is 50. The range site of the Aberdeen soil is Clayey, and that of the Exline soil is Thin Claypan.

4—Rosewood fine sandy loam. This deep, level, poorly drained, highly calcareous soil is in shallow depressions on lake plains and outwash plains. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 9 inches thick. The subsoil is dark gray, mottled fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is grayish brown and mottled. It is loamy fine sand in the upper part and fine sand in the lower part.

Included with this soil in mapping are small areas of Hamar, Stirum, Ulen, and Wyndmere soils. These soils make up about 10 percent of the unit. The Hamar soils are not calcareous. The Stirum soils have a sodic subsoil. They are in the deepest part of the depressions. The poorly drained Hamar and somewhat poorly drained Ulen and Wyndmere soils occur as areas intermingled with areas of the Rosewood soil.

Permeability is moderately rapid in the Rosewood soil. Runoff is slow. Available water capacity is low. Organic matter content is high. A seasonal high water table is within a depth of 2 feet. Tilth is good.

Most areas are used for cultivated crops. If drained, this soil is suited to small grain and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are overcoming wetness and controlling soil blowing. The water is removed from most areas by natural runoff, deep seepage, or a system of constructed drains. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem, indiangrass, and switchgrass. Creeping foxtail, meadow fescue, meadow foxtail, and alsike clover are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods. The wetness interferes with haying in some years.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can

improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIw. The productivity index for spring wheat is 49. The range site is Subirrigated.

6—Parnell silty clay loam. This deep, level, very poorly drained soil is in depressions on till plains and moraines. It is subject to ponding. Individual areas range from about 3 to more than 20 acres in size.

Typically, the surface soil is black silty clay loam about 11 inches thick. It is mottled in the lower part. The upper part of the subsoil is black silty clay about 30 inches thick. The lower part to a depth of about 60 inches is very dark gray, mottled clay. In places the subsoil is calcareous within a depth of 10 inches.

Included with this soil in mapping are small areas of Tonka and Vallers soils. These soils make up about 10 percent of the unit. The poorly drained Tonka soils are in the shallower part of the depressions. They have a subsurface layer. The poorly drained Vallers soils surround the depressions. They have a layer of lime accumulation within a depth of 16 inches.

Permeability is slow in the Parnell soil. Runoff is ponded. Available water capacity is high. Organic matter content is very high. A seasonal high water table is 2 feet above to 2 feet below the surface. Tilth is fair.

Most areas are used for cultivated crops. If undrained, this soil is best suited to hay, range, and wetland wildlife habitat. Drained areas are suited to small grain, flax, and sunflowers and to grass-legume hay. The hazard of soil blowing or water erosion is slight. In undrained areas, tillage, seeding, or harvest operations are usually delayed or prevented by ponded surface water and crops are harvested in only about 3 to 5 years out of 10. Areas of this soil and the ponded water provide feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural wetness and preventing siltation.

In areas where this soil is used for range, the important native forage plants are rivergrass, slough sedge, and prairie cordgrass. In drained areas reed canarygrass and creeping foxtail are suitable hay and pasture plants. Trampling, compaction, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIIw. The productivity index for spring wheat ranges from 20 to 59, depending on the degree of drainage. The range site is Wetland.

7—Southam silt loam. This deep, level, very poorly drained soil is in deep depressions on till plains, moraines, and lake plains. It is subject to ponding. Individual areas range from about 3 to more than 50 acres in size.

Typically, a 6-inch cover of partially decomposed leaves, stems, and roots is at the surface. The surface soil is about 24 inches thick. It is black silt loam in the upper part, black silty clay loam in the next part, and very dark gray, mottled clay loam in the lower part. The substratum to a depth of about 60 inches is olive gray and mottled. It is silty clay loam in the upper part and clay in the lower part.

Included with this soil in mapping are small areas of Parnell and Vallers soils on the rims of the depressions and small areas of soils that have a gravelly substratum. These soils make up about 5 to 15 percent of the unit. The Parnell soils have accumulated clay in the subsoil. The Vallers soils have accumulated lime in the subsoil.

Permeability is slow in the Southam soil. Runoff is ponded. Available water capacity is high. Organic matter content is very high. A seasonal high water table is 5 feet above to 1 foot below the surface.

Most areas are used as wetland wildlife habitat. Because of wetness and ponding, this soil generally is unsuited to cultivated crops, range, hay, trees, and shrubs. It is best suited to wetland wildlife habitat. The hazard of soil blowing or water erosion is slight. Areas of this soil and the ponded water provide excellent winter cover for resident wildlife and feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural wetness and preventing siltation.

The land capability classification is VIIIw. The productivity index for spring wheat is 0. A range site is not assigned.

8—Tonka silt loam. This deep, level, poorly drained soil is in shallow depressions on till plains and moraines. It is subject to ponding. Individual areas range from about 3 to more than 20 acres in size.

Typically, the surface soil is black silt loam about 13

inches thick. The subsurface layer is very dark gray, mottled silt loam about 5 inches thick. The subsoil is about 16 inches thick. It is very dark gray silty clay in the upper part and dark gray, mottled clay in the lower part. The next layer is olive gray, mottled silty clay loam about 9 inches thick. The substratum to a depth of about 60 inches is olive, mottled silty clay loam.

Included with this soil in mapping are small areas of Hamerly, Parnell, and Vallers soils. These soils make up about 5 to 20 percent of the unit. The somewhat poorly drained Hamerly and poorly drained Vallers soils are on the rims of the depressions. They are highly calcareous. The very poorly drained Parnell soils are in the deeper part of the depressions. They have a silty clay loam surface layer.

Permeability is slow in the Tonka soil. Runoff is ponded. Available water capacity and organic matter content are high. A seasonal high water table is 0.5 foot above to 1.0 foot below the surface. Tilth is good.

Most areas are used for cultivated crops, but some are used for hay, range, or wetland wildlife habitat. If drained, this soil is suited to small grain, flax, and sunflowers and to grass-legume hay. Locating suitable drainage outlets generally is difficult. As a result, few areas are drained. The wetness in undrained areas delays tillage, seeding, or harvest operations in most years and prevents them in some years. Crops are harvested in only about 6 to 8 years out of 10. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

Areas of this soil and the ponded water provide an early season breeding site and a good source of invertebrate protein for wetland wildlife. The main concerns in managing wildlife habitat are maintaining the natural wetness and preventing siltation.

In areas where this soil is used for range, the important native forage plants are slim sedge, wooly sedge, and prairie cordgrass. Creeping foxtail, reed canarygrass, switchgrass, and alsike clover are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIw. The productivity index for spring wheat ranges from 40 to 70, depending on the degree of drainage. The range site is Wet Meadow.

9—Bearden silt loam. This deep, level, somewhat poorly drained, highly calcareous soil is on flats on lake plains. Individual areas range from about 10 to more than 300 acres in size.

Typically, the surface soil is black silt loam about 13 inches thick. The subsoil is silty clay loam about 23 inches thick. It is dark grayish brown in the upper part and light olive brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is light olive brown and light olive gray in the upper part and olive and light gray in the lower part. In some places the surface layer is loam or silty clay loam. In other places the soil has less clay throughout.

Included with this soil in mapping are small areas of Colvin soils. These soils make up about 10 to 20 percent of the unit. They occur as areas intermingled with areas of the Bearden soil. They are poorly drained.

Permeability is moderately slow in the Bearden soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 2 to 4 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling soil blowing. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem, indiangrass, and switchgrass. Tall wheatgrass, birdsfoot trefoil, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of annual cover crops between the rows of trees

and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIe. The productivity index for spring wheat is 89. The range site is Limy Subirrigated.

10—Glyndon silt loam, saline. This deep, level, somewhat poorly drained, highly calcareous, moderately saline soil is on flats on lake plains. Individual areas range from about 10 to more than 300 acres in size.

Typically, the surface layer is black silt loam about 9 inches thick. The subsoil is light brownish gray silt loam about 12 inches thick. It is mottled between depths of 15 and 21 inches. The substratum to a depth of about 60 inches is light brownish gray, mottled very fine sandy loam.

Included with this soil in mapping are small areas of Overly and Wyndmere soils. These soils make up about 5 to 15 percent of the unit. The Overly soils are on slight rises. They are better drained than the Glyndon soil and do not have an accumulation of lime within a depth of 16 inches. The Wyndmere soils occur as areas intermingled with areas of the Glyndon soil. They have more sand throughout than the Glyndon soil.

Permeability is moderate in the Glyndon soil. Runoff is slow. Available water capacity is moderate. Organic matter content is high. A seasonal high water table is at a depth of 2.5 to 6.0 feet. Tilth is good. Salts reduce the amount of water available to plants.

Most areas are used for cultivated crops. This soil is best suited to salt-tolerant crops, hay, pasture, and range. Because of the salinity, it is poorly suited to small grain, flax, and sunflowers. The main concerns in managing cultivated areas are overcoming salinity and wetness and controlling soil blowing. Increased salinity has been observed in some drained areas. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, windbreaks, and buffer strips help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. A permanent cover of crops or crop residue helps to control the accumulation of salts in the surface layer by reducing the evaporation rate at the surface. Growing salt-tolerant crops, such as barley, helps to overcome the salinity.

In areas where this soil is used for range, the important native forage plants are inland saltgrass, slender wheatgrass, and western wheatgrass. Tall wheatgrass is a suitable hay and pasture plant. The high content of salts and the limited available water capacity are problems, especially if the range or pasture is overgrazed. Trampling, compaction, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods. Maintaining an adequate cover of the salt-tolerant plants helps to control soil blowing and to leach salts from the root zone. Stock water ponds constructed in areas of this soil frequently contain salty water.

This soil is suited to only a few of the most salt-tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the reduced amount of available water caused by the salts in the soil. Reducing the evaporation rate at the surface improves seedling survival. When the bare soil surface dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIs. The productivity index for spring wheat is 43. The range site is Saline Lowland.

12B—Arvilla fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and undulating, somewhat excessively drained soil is on flats and rises on outwash plains and terraces. Individual areas range from about 3 to more than 100 acres in size.

Typically, the surface layer is black fine sandy loam about 9 inches thick. The subsoil is very dark grayish brown and is about 10 inches thick. It is fine sandy loam in the upper part and sandy loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, stratified coarse sand and gravelly coarse sand.

Included with this soil in mapping are small areas of Fordville and Renshaw soils. These soils make up about 5 to 20 percent of the unit. They occur as areas intermingled with areas of the Arvilla soil. They have a surface layer and subsoil of loam.

Permeability is moderately rapid in the upper part of the Arvilla soil and very rapid in the lower part. Runoff is slow. Available water capacity is low. Organic matter content is moderate. Tilth is fair. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops or for pasture. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. It is best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concerns in managing cultivated areas are overcoming droughtiness and controlling soil blowing. The hazard of soil blowing is severe, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control

soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where this soil is used for range, the important native forage plants are needleandthread and blue grama. Intermediate wheatgrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

This soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It is droughty, and the trees and shrubs are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIe. The productivity index for spring wheat is 40. The range site is Shallow to Gravel.

13—Rosewood fine sandy loam, wet. This deep, level, very poorly drained, highly calcareous soil is in shallow depressions on lake plains and outwash plains. It is subject to ponding. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 9 inches thick. The subsoil is dark gray, mottled fine sandy loam about 8 inches thick. The substratum to a depth of about 60 inches is grayish brown and mottled. It is loamy fine sand in the upper part and fine sand in the lower part. In some places the substratum is olive brown. In other places the soil does not have a subsoil.

Included with this soil in mapping are small areas of Stirum and Ulen soils. These soils make up about 10 percent of the unit. The poorly drained Stirum and somewhat poorly drained Ulen soils occur as areas intermingled with areas of the Rosewood soil.

Permeability is moderately rapid in the Rosewood soil. Runoff is ponded. Available water capacity is low. Organic matter content is high. A seasonal high water table is 1 foot above to 1 foot below the surface. Tilth is good.

Most areas are used for range, hay, pasture, or wetland wildlife habitat. This soil is best suited to these uses. The main concerns in managing cultivated areas are controlling soil blowing and overcoming wetness. If drained, the soil is suited to small grain, flax, and sunflowers. Locating suitable drainage outlets is difficult. As a result, few areas are drained. In undrained areas, tillage, seeding, or harvest operations are usually prevented or delayed by the wetness and crops are harvested in only about 3 to 5 years out of 10. The hazard of soil blowing is severe, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing.

Areas of this soil and the ponded water provide feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural wetness and preventing siltation.

The important native forage plants are rivergrass, prairie cordgrass, and slough sedge. In drained areas creeping foxtail, meadow fescue, meadow foxtail, and alsike clover are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIw. The productivity index for spring wheat ranges from 10 to 50, depending on the degree of drainage. The range site is Wetland.

14—Barnes-Gardena loams, 1 to 3 percent slopes. These deep, nearly level soils are on till plains intermingled with small lake plains. The well drained Barnes soil is on rises. The moderately well drained Gardena soil is in swales. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 45 to 65 percent Barnes soil and 35 to 50 percent Gardena soil. The two soils occur as areas

so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Typically, the Gardena soil has a black loam surface soil about 12 inches thick. The subsoil is loam about 26 inches thick. It is very dark grayish brown in the upper part and light olive brown in the lower part. The substratum to a depth of about 60 inches is mottled very fine sandy loam. It is light olive brown in the upper part, olive gray in the next part, and light olive brown and light gray in the lower part. In places the dark surface layer extends to a depth of only 8 to 16 inches.

Included with these soils in mapping are small areas of Buse, Cresbard, Hamerly, and Tonka soils. These included soils make up about 5 to 20 percent of the unit. The Buse soils are on knolls and ridges. They have a subsoil that is calcareous throughout. The Cresbard soils occur as areas intermingled with areas of the Barnes soil. They have a dense, sodic subsoil. The somewhat poorly drained Hamerly soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches. The poorly drained Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately slow in the Barnes soil and moderate in the Gardena soil. Runoff is slow on both soils. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet in the Gardena soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are maintaining fertility and tilth. Incorporating organic material into the surface layer improves tilth and fertility. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, pubescent wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. No major problems affect the use of these soils for range or pasture.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Gardena soil is suited to all climatically adapted species. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Barnes soil is IIc, and that of the Gardena soil is IIe. The productivity index of the unit for spring wheat is 92. The range site of both soils is Silty.

15—Barnes-Svea loams, 1 to 3 percent slopes. These deep, nearly level soils are on till plains. The well drained Barnes soil is on rises. The moderately well drained Svea soil is in swales. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 55 to 65 percent Barnes soil and 20 to 30 percent Svea soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is about 29 inches thick. In sequence downward, it is very dark gray loam; very dark grayish brown loam; dark grayish brown loam; and light olive brown, mottled clay loam. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam. In places the subsoil has more clay.

Included with these soils in mapping are small areas of Buse, Cresbard, Hamerly, and Tonka soils. These included soils make up about 5 to 25 percent of the unit. The Buse soils are on knolls and ridges. They have a subsoil that is calcareous throughout. The Cresbard soils occur as areas intermingled with areas of the Svea soil. They have a dense, sodic subsoil. The somewhat poorly drained Hamerly soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches. The poorly drained Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately slow in the Barnes and Svea soils. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet in the Svea soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is maintaining fertility and tilth. Incorporating organic material into the surface layer helps to maintain or improve tilth and fertility. The

hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion (fig. 6). Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, and big bluestem. Intermediate wheatgrass, smooth brome, Russian wildrye, and alfalfa are suitable hay and pasture plants. No major problems affect the use of these soils for range or pasture.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Svea soil is suited to all climatically adapted species. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIc. The productivity index of the unit for spring wheat is 88. The range site of the Barnes soil is Silty, and that of the Svea soil is Overflow.

15B—Barnes-Svea loams, 3 to 6 percent slopes. These deep, undulating soils are on till plains. The well drained Barnes soil is on rises. The moderately well drained Svea soil is in swales. Individual areas of this unit range from about 10 to more than 500 acres in size. They are about 50 to 65 percent Barnes soil and 25 to 40 percent Svea soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is about 29 inches thick. In sequence downward, it is very dark gray loam; very dark grayish brown loam; dark grayish brown loam; and light olive brown, mottled clay loam. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam.

Included with these soils in mapping are small areas of Buse, Cresbard, Hamerly, and Tonka soils. These included soils make up about 5 to 25 percent of the unit. The well drained Buse soils are on knolls and knobs. They have a subsoil that is calcareous throughout. The Cresbard soils occur as areas intermingled with areas of the Svea soil. They have a dense, sodic subsoil. The somewhat poorly drained Hamerly soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches. The poorly drained Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately slow in the Barnes and Svea soils. Runoff is medium. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet in the Svea soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling water erosion. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, Russian wildrye, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Svea soil is suited to all climatically adapted species. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIe. The productivity index of the unit for spring wheat is 74. The range site is Silty.

16B—Barnes-Cresbard loams, 2 to 6 percent slopes. These deep, nearly level and undulating soils are on till plains. The well drained Barnes soil is on rises. The moderately well drained, sodic Cresbard soil is in swales. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 50 to 60 percent Barnes soil and 30 to 40 percent Cresbard soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive

Figure 6.—Stubble in an area of Barnes-Svea loams, 1 to 3 percent slopes.

brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Typically, the surface layer of the Cresbard soil is loam about 9 inches thick. The upper part is black, and the lower part is very dark gray. The next layer is about 3 inches thick. It is black loam that has grayish brown silt coatings. The subsoil is dense clay loam about 22 inches thick. It is very dark grayish brown in the upper part, dark grayish brown in the next part, and light olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam. In some places the subsoil is very dense. In other places it contains less clay.

Included with these soils in mapping are small areas of Buse, Hamerly, and Tonka soils. These included soils make up about 5 to 20 percent of the unit. The Buse soils are on knolls and knobs. They have a subsoil that is calcareous throughout. The somewhat poorly drained Hamerly soils are on the rims of depressions. They have an accumulation of lime within a depth of 16

inches. The poorly drained Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately slow in the Barnes soil and slow in the Cresbard soil. Runoff is medium on both soils. Available water capacity and organic matter content are high in the Barnes soil and moderate in the Cresbard soil. A seasonal high water table is at a depth of 4 to 6 feet in the Cresbard soil. Tilth is good in the Barnes soil and fair in the Cresbard soil. The dense, sodic subsoil of the Cresbard soil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, and sunflowers. The main concerns in managing cultivated areas are maintaining tilth and controlling water erosion. Because of moisture stress in most years, crop growth on the Cresbard soil is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts in the Cresbard soil adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the Cresbard soil. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, needleandthread, and green needlegrass. Pubescent wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cresbard soil is suited to many of the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Individual trees and shrubs on the Cresbard soil vary in height, density, and vigor. They are affected by the restricted root development in the subsoil and by the reduced amount of available water caused by the salts in the soil.

The land capability classification of the Barnes soil is IIe, and that of the Cresbard soil is IIIe. The productivity index of the unit for spring wheat is 70. The range site of the Barnes soil is Silty, and that of the Cresbard soil is Clayey.

17B—Barnes-Buse loams, 3 to 6 percent slopes. These deep, undulating, well drained soils are on till plains. The Barnes soil is on side slopes. The Buse soil is on ridges and knolls. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 60 to 75 percent Barnes soil and 20 to 35 percent Buse soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Typically, the surface layer of the Buse soil is black loam about 6 inches thick. The subsoil is dark grayish brown loam about 11 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled loam. In places the surface layer is grayish brown and is only 3 to 5 inches thick.

Included with these soils in mapping are small areas of the moderately well drained Cresbard and Svea soils in swales. These included soils make up about 5 to 20 percent of the unit. The Cresbard soils have a dense, sodic subsoil. The Svea soils have a surface layer that is dark to a depth of more than 16 inches.

Permeability is moderately slow in the Barnes and Buse soils. Runoff is medium. Available water capacity is high. Organic matter content is high in the Barnes soil and moderate in the Buse soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling soil blowing and water erosion. The hazard of soil blowing is moderate on the Buse soil and slight on the Barnes soil. The hazard of water erosion is moderate on both soils. Field windbreaks, stripcropping, and a system of conservation tillage that leaves crop residue on the surface help to control water erosion and soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, little bluestem, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing and water erosion are hazards, especially

if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing and water erosion.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Buse soil is suited only to the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on this soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Barnes soil is IIe, and that of the Buse soil is IIIe. The productivity index of the unit for spring wheat is 68. The range site of the Barnes soil is Silty, and that of the Buse soil is Thin Upland.

17C—Barnes-Buse loams, 6 to 9 percent slopes. These deep, gently rolling, well drained soils are on till plains and moraines. The Barnes soil is on summits and side slopes. The Buse soil is on ridges and shoulder slopes. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 60 to 70 percent Barnes soil and 30 to 40 percent Buse soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In some places along Maple Creek, the surface layer is fine sandy loam.

Typically, the surface layer of the Buse soil is black loam about 6 inches thick. The subsoil is dark grayish brown loam about 11 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled loam. In places the surface layer is grayish brown and is only 3 to 5 inches thick.

Included with these soils in mapping are small areas of the moderately well drained Svea soils in swales. These included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Barnes and Buse soils. Runoff is rapid. Available water capacity is high. Organic matter content is high in the Barnes soil and moderate in the Buse soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling soil blowing and water erosion. The hazard of soil blowing is slight on the Barnes soil and moderate on the Buse soil. The hazard of water erosion is moderate on both soils. A system of conservation tillage that leaves crop residue on the surface, buffer strips, field windbreaks, and grassed waterways in areas where runoff concentrates help to control water erosion and soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, little bluestem, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing and water erosion are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing and water erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Buse soil is suited only to the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on this soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Barnes soil is IIIe, and that of the Buse soil is IVe. The productivity index of the unit for spring wheat is 54. The range site of the Barnes soil is Silty, and that of the Buse soil is Thin Upland.

18B—Barnes-Cavour loams, 1 to 6 percent slopes. These deep, nearly level and undulating soils are on till plains. The well drained Barnes soil is on rises. The moderately well drained, sodic Cavour soil is in swales and on flats. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 45 to 60 percent Barnes soil and 35 to 45 percent Cavour soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18

inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Typically, the surface layer of the Cavour soil is loam about 9 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsurface layer is dark gray loam about 3 inches thick. The subsoil is dense clay loam about 19 inches thick. It is very dark brown in the upper part, very dark grayish brown in the next part, and olive brown in the lower part. The substratum to a depth of about 60 inches is grayish brown loam. In places the subsoil is loam and is only moderately dense.

Included with these soils in mapping are small areas of Hamerly, Parnell, and Tonka soils. These included soils make up about 5 to 20 percent of the unit. The somewhat poorly drained Hamerly soils are on flats adjacent to depressions. They have an accumulation of lime within a depth of 16 inches. The very poorly drained Parnell and poorly drained Tonka soils are in depressions. The Parnell soils have a silty clay loam surface layer. The Tonka soils have a subsurface layer.

Permeability is moderately slow in the Barnes soil and very slow in the Cavour soil. Runoff is medium on both soils. Available water capacity and organic matter content are high in the Barnes soil and moderate in the Cavour soil. A seasonal high water table is at a depth of 4 to 6 feet in the Cavour soil. Tilth is good in the Barnes soil and fair in the Cavour soil. The dense, sodic subsoil of the Cavour soil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling water erosion and maintaining tilth. Because of moisture stress in most years, crop growth on the Cavour soil is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts in the Cavour soil adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the dense, sodic subsoil (fig. 7). The hazard of soil blowing is slight, and the hazard of water erosion is moderate. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, needleandthread, and blue grama. Intermediate wheatgrass, pubescent wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. The dense, sodic subsoil of the Cavour soil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas of the Cavour soil. Maintaining an adequate cover of the important plants or of other suitable plants helps to prevent denuding.

The Barnes soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cavour soil is suited only to a few of the drought- and salt-tolerant species. Supplemental watering or irrigation helps to ensure the survival of seedlings. Individual trees and shrubs on the Cavour soil vary in height, density, and vigor. They are affected by restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Barnes soil is IIe, and that of the Cavour soil is IVs. The productivity index of the unit for spring wheat is 61. The range site of the Barnes soil is Silty, and that of the Cavour soil is Claypan.

19E—Buse-Barnes loams, 9 to 25 percent slopes. These deep, rolling and hilly, well drained soils are on till plains and moraines. The Buse soil is on knolls and ridges. The Barnes soil is on side slopes. Individual areas of this unit range from about 5 to more than 200 acres in size. They are about 50 to 65 percent Buse soil and 35 to 45 percent Barnes soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Buse soil is black loam about 6 inches thick. The subsoil is dark grayish brown loam about 11 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled loam.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Included with these soils in mapping are small areas of the moderately well drained Svea soils in swales. These included soils make up about 10 to 15 percent of the unit.

Figure 7.—Alfalfa in an area of Barnes-Cavour loams, 1 to 6 percent slopes.

Permeability is moderately slow in the Barnes and Buse soils. Runoff is very rapid. Available water capacity is high. Organic matter content is high in the Barnes soil and moderate in the Buse soil.

Most areas are used for range or wildlife habitat. Because of the slope and the hazard of erosion, these soils generally are unsuited to cultivated crops. They are best suited to pasture, range, and wildlife habitat. The important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, Russian wildrye, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion and soil

blowing. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

These soils generally are unsuited to the trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs for esthetic or wildlife purposes can be planted if special treatment, such as hand or scalp planting, is applied.

The land capability classification of the Buse soil is VIIe, and that of the Barnes soil is VIe. The productivity index of the unit for spring wheat is 0. The range site of the Buse soil is Thin Upland, and that of the Barnes soil is Silty.

21—Cavour-Miranda loams, 1 to 3 percent slopes. These deep, nearly level soils are on till plains. The well drained, sodic Cavour soil is on flats and rises. The moderately well drained, moderately saline, sodic Miranda soil is on flats and in swales. Individual areas of this unit range from about 10 to more than 400 acres in size. They are about 55 to 70 percent Cavour soil and 25 to 40 percent Miranda soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Cavour soil is loam about 9 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsurface layer is dark gray loam about 3 inches thick. The subsoil is dense clay loam about 19 inches thick. It is very dark brown in the upper part, very dark grayish brown in the next part, and olive brown in the lower part. The substratum to a depth of about 60 inches is grayish brown loam. In places the subsoil is only moderately dense.

Typically, the surface layer of the Miranda soil is black loam about 4 inches thick. The subsoil is dense clay loam about 23 inches thick. It is very dark brown in the upper part, very dark grayish brown in the next part, and light olive brown in the lower part. The substratum to a depth of about 60 inches is olive clay loam.

Included with these soils in mapping are small areas of the well drained, nonsodic Barnes soils on rises. These included soils make up about 5 to 20 percent of the unit.

Permeability is very slow in the Cavour and Miranda soils. Runoff is slow. Available water capacity is moderate. Organic matter content also is moderate. Tilth is fair. The dense, sodic subsoil in both soils restricts the depth to which roots can penetrate, and salts reduce the amount of water available to plants.

Most areas are used for cultivated crops. These soils are poorly suited to wheat, flax, and sunflowers but are suited to grass-legume hay. The main concerns in managing cultivated areas are improving root penetration in the dense, sodic subsoil of both soils and improving tilth. Because of moisture stress in most years, crop growth is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts in both soils adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soils are neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the dense, sodic subsoil. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, blue grama, and inland saltgrass. Crested wheatgrass, intermediate wheatgrass, tall wheatgrass, and alfalfa are suitable hay and pasture plants. The dense, sodic subsoil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important plants or of other suitable plants helps to prevent denuding. Stock water ponds constructed in areas of the Miranda soil sometimes contain salty water.

The Cavour soil is suited to only a few of the drought- and salt-tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Miranda soil generally is unsuited to these uses. Supplemental watering or irrigation helps to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soils.

The land capability classification of the Cavour soil is IVs, and that of the Miranda soil is VIs. The productivity index of the unit for spring wheat is 34. The range site of the Cavour soil is Claypan, and that of the Miranda soil is Thin Claypan.

22—Colvin silt loam. This deep, level, poorly drained, highly calcareous soil is on flats on lake plains and in drainageways on till plains. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is black silt loam about 7 inches thick. The next layer is very dark gray silt loam about 14 inches thick. The subsoil is olive gray silty clay loam about 15 inches thick. The substratum to a depth

of about 60 inches is olive gray, mottled silty clay loam. In places the substratum is olive brown.

Included with this soil in mapping are small areas of poorly drained soils that have a substratum of gravelly sand or sand. These soils make up about 10 percent of the unit. They occur as areas intermingled with areas of the Colvin soil.

Permeability is moderately slow in the Colvin soil. Runoff is very slow. Available water capacity and organic matter content are high. A seasonal high water table is within a depth of 1 foot. Tilth is good.

Most areas are used for range, hay, or wetland wildlife habitat. This soil is best suited to these uses. If drained, it is suited to small grain, flax, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling soil blowing and overcoming wetness. Locating suitable drainage outlets is difficult. As a result, few areas are drained. In undrained areas, tillage, seeding, or harvest operations are usually prevented or delayed by the ponded surface water and crops are harvested in only about 6 to 8 years out of 10. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves plant residue on the surface help to control soil blowing.

This soil provides feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural wetness and preventing siltation.

The important native forage plants are slim sedge, wooly sedge, and prairie cordgrass. In drained areas reed canarygrass and creeping foxtail are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIw. The productivity index for spring wheat ranges from 35 to 65, depending on the degree of drainage. The range site is Wet Meadow.

23—Colvin silt loam, wet. This deep, level, very poorly drained, highly calcareous soil is in shallow depressions on lake plains and in drainageways on till plains. It is subject to ponding. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is black silt loam about 7 inches thick. The next layer is very dark gray silt loam about 14 inches thick. The subsoil is olive gray silty clay loam about 15 inches thick. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In places the substratum is olive brown.

Included with this soil in mapping are small areas of poorly drained soils. These soils make up about 10 percent of the unit. They occur as areas intermingled with areas of the Colvin soil.

Permeability is moderately slow in the Colvin soil. Runoff is ponded. Available water capacity and organic matter content are high. A seasonal high water table is 1 foot above to 1 foot below the surface. Tilth is fair.

Most areas are used for range, hay, or wetland wildlife habitat. This soil is best suited to these uses. The main concerns in managing cultivated areas are controlling soil blowing and overcoming wetness. If drained, the soil is suited to small grain, flax, and sunflowers. Locating suitable drainage outlets is difficult. As a result, few areas are drained. In undrained areas, tillage, seeding, or harvest operations are usually prevented or delayed by the ponded surface water and crops are harvested in only about 3 to 5 years out of 10. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves plant residue on the surface help to control soil blowing.

Areas of this soil and the ponded water provide feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural wetness and preventing siltation.

The important native forage plants are slough sedge and rivergrass. In drained areas reed canarygrass and creeping foxtail are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can

improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIw. The productivity index for spring wheat ranges from 10 to 60, depending on the degree of drainage. The range site is Wetland.

24—Gardena loam, 0 to 3 percent slopes. This deep, level and nearly level, moderately well drained soil is on flats on lake plains. Individual areas range from about 10 to more than 150 acres in size.

Typically, the surface soil is black loam about 12 inches thick. The subsoil is loam about 26 inches thick. It is very dark grayish brown in the upper part and light olive brown in the lower part. The substratum to a depth of about 60 inches is mottled very fine sandy loam. It is light olive brown in the upper part, olive gray in the next part, and light olive brown and light gray in the lower part. In some places the dark surface layer extends to a depth of only 8 to 16 inches. In other places the subsoil has more clay.

Included with this soil in mapping are small areas of Embden soils. These soils make up about 5 to 10 percent of the unit. They occur as areas intermingled with areas of the Gardena soil. They have less silt and more sand than the Gardena soil.

Permeability is moderate in the Gardena soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are maintaining fertility and tilth and controlling erosion. Incorporating organic material into the surface layer improves fertility and tilth. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, Russian wildrye, and alfalfa are suitable hay and pasture plants. Soil erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control erosion.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIe. The productivity index for spring wheat is 97. The range site is Silty.

25—Divide loam, 0 to 2 percent slopes. This deep, level and nearly level, somewhat poorly drained, highly calcareous soil is on flats on outwash plains. Individual areas range from about 2 to more than 100 acres in size.

Typically, the surface soil is black loam about 10 inches thick. The next layer is very dark gray loam about 3 inches thick. The subsoil is about 15 inches thick. It is light brownish gray loam in the upper part and dark gray, mottled gravelly loam in the lower part. The substratum to a depth of about 60 inches is olive brown very gravelly coarse sand. In places the soil is moderately well drained.

Included with this soil in mapping are small areas of the well drained Fordville soils. These soils occur as areas intermingled with areas of the Divide soil. They make up about 5 to 20 percent of the unit.

Permeability is moderate in the upper part of the Divide soil and very rapid in the lower part. Runoff is slow. Available water capacity is moderate. Organic matter content is high. A seasonal high water table is at a depth of 2.5 to 5.0 feet. Tilth is good. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. It is best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concerns in managing cultivated areas are maintaining fertility and tilth and controlling soil blowing. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are little bluestem and big bluestem. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and

environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIs. The productivity index for spring wheat is 51. The range site is Limy Subirrigated.

26B—Eckman-Gardena silt loams, 3 to 6 percent slopes. These deep, undulating soils are on lake plains. The well drained Eckman soil is on rises. The moderately well drained Gardena soil is in swales. Individual areas of this unit range from about 10 to more than 150 acres in size. They are about 60 to 75 percent Eckman soil and 25 to 35 percent Gardena soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Eckman soil is black silt loam about 7 inches thick. The subsoil is about 28 inches thick. It is very dark grayish brown silt loam in the upper part, dark grayish brown silt loam in the next part, and grayish brown very fine sandy loam in the lower part. The substratum to a depth of about 60 inches is light olive brown very fine sandy loam. In places the soil is loam or clay loam throughout.

Typically, the Gardena soil has a black silt loam surface soil about 12 inches thick. The subsoil is silt loam about 26 inches thick. It is very dark grayish brown in the upper part and light olive brown in the lower part. The substratum to a depth of about 60 inches is mottled very fine sandy loam. It is light olive brown in the upper part, olive gray in the next part, and light olive brown and light gray in the lower part. In some places the subsoil is clay loam.

Included with these soils in mapping are small areas of Embden and Glyndon soils. These included soils make up about 5 to 15 percent of the unit. The Embden soils occur as areas intermingled with areas of the Gardena soil. They contain less silt and more sand than the Gardena soil. The Glyndon soils are in swales. They are somewhat poorly drained.

Permeability is moderate in the Eckman and Gardena soils. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet in the Gardena soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are maintaining tilth and fertility and controlling water erosion. Incorporating organic material into the surface layer helps to maintain or improve tilth and fertility. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. A system of conservation tillage that leaves crop residue on the surface helps to control water erosion. Conservation tillage also helps to maintain fertility and tilth and to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, switchgrass, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion.

The Eckman soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Gardena soil is suited to all of the climatically adapted species. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIe. The productivity index of the unit for spring wheat is 83. The range site is Silty.

27B—Embden sandy loam, 1 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on flats and rises on outwash plains. Individual areas range from about 5 to more than 100 acres in size.

Typically, the surface soil is black sandy loam about 10 inches thick. The subsoil is about 29 inches thick. It is very dark grayish brown fine sandy loam in the upper part, dark brown loamy fine sand in the next part, and dark grayish brown sandy loam in the lower part. The upper part of the substratum is dark grayish brown loamy fine sand. The lower part to a depth of about 60 inches is olive brown sandy loam. In places the dark surface layer extends to a depth of only 8 to 15 inches.

Included with this soil in mapping are small areas of Svea, Swenoda, and Wyndmere soils. These soils make up about 10 to 15 percent of the unit. The Svea soils are in swales. They have a subsoil of loam and clay loam. The Swenoda soils occur as areas intermingled with areas of the Embden soil. They have a substratum of loam. The Wyndmere soils are in swales. They have an accumulation of lime within a depth of 16 inches.

Permeability is moderately rapid in the Embden soil. Runoff is slow. Available water capacity is moderate. Organic matter content is high. A seasonal high water

table is at a depth of 4 to 6 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling soil blowing. The hazard of soil blowing is severe, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are prairie sandreed, needleandthread, and blue grama. Intermediate wheatgrass, smooth brome, alfalfa, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the pasture or range is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIe. The productivity index for spring wheat is 76. The range site is Sandy.

28B—Clontarf fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and undulating, moderately well drained soil is on flats and rises on outwash plains. Individual areas range from about 10 to more than 80 acres in size.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 20 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is olive brown, mottled fine sand. In places the soil is fine sandy loam throughout.

Included with this soil in mapping are small areas of Hecla, Swenoda, Towner, and Wyndmere soils. These soils make up about 10 to 15 percent of the unit. The Hecla, Swenoda, and Towner soils occur as areas intermingled with areas of the Clontarf soil. The Hecla soils contain more sand in the upper part than the Clontarf soil. The Swenoda soils have a substratum of loam. The Towner soils are silt loam in the lower part of the substratum. The Wyndmere soils are in swales. They have an accumulation of lime within a depth of 16 inches.

Permeability is moderately rapid in the Clontarf soil. Runoff is slow. Available water capacity is moderate. Organic matter content is high. A seasonal high water table is at a depth of 3 to 5 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling soil blowing. The hazard of soil blowing is severe, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are prairie sandreed and needleandthread. Intermediate wheatgrass, smooth brome, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the pasture or range is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It is somewhat droughty, and the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIe. The productivity index for spring wheat is 63. The range site is Sandy.

29—Glyndon silt loam, 0 to 3 percent slopes. This deep, level and nearly level, somewhat poorly drained, highly calcareous soil is on flats on lake plains. Individual areas range from about 10 to more than 300 acres in size.

Typically, the surface layer is black silt loam about 9 inches thick. The subsoil is light brownish gray silt loam about 12 inches thick. It is mottled between depths of 15 and 21 inches. The substratum to a depth of about 60 inches is light brownish gray, mottled very fine sandy loam. In places the soil has more clay.

Included with this soil in mapping are small areas of Bearden, Gardena, and Wyndmere soils. These soils make up about 5 to 20 percent of the unit. The Bearden

and Wyndmere soils occur as areas intermingled with areas of the Glyndon soil. The Bearden soils contain more clay throughout than the Glyndon soil. The Wyndmere soils contain more sand throughout than the Glyndon soil. The Gardena soils are on rises. They have a surface layer and subsoil of loam.

Permeability is moderate in the Glyndon soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 2.5 to 6.0 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling soil blowing and maintaining tilth. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to maintain tilth and to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem, switchgrass, and little bluestem. Tall wheatgrass, birdsfoot trefoil, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIe. The productivity index for spring wheat is 80. The range site is Limy Subirrigated.

31—Edgeley loam, 1 to 3 percent slopes. This moderately deep, nearly level, well drained soil is on flats on till plains. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is black loam about 6 inches thick. The next layer is very dark brown loam about 9 inches thick. The subsoil is dark brown loam about 11 inches thick. The substratum is dark brown channery loam about 8 inches thick. Very dark grayish brown shale bedrock is at a depth of about 34 inches. In some places the shale bedrock is within a depth of 20 inches. In other places it is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of the moderately well drained, sodic Cavour soils in swales. These soils make up about 10 to 15 percent of the unit.

Permeability is moderate in the Edgeley soil. Runoff is slow. Available water capacity is low. Organic matter content is high. Tilth is good. The shale bedrock restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is maintaining tilth and fertility. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIc. The productivity index for spring wheat is 74. The range site is Silty.

31B—Edgeley loam, 3 to 6 percent slopes. This moderately deep, undulating, well drained soil is on rises on till plains. Individual areas range from about 10 to more than 50 acres in size.

Typically, the surface layer is black loam about 7 inches thick. The next layer is very dark brown loam about 9 inches thick. The subsoil is dark brown loam about 11 inches thick. The substratum is dark brown channery loam about 7 inches thick. Dark grayish brown shale bedrock is at a depth of about 34 inches. In some places the shale bedrock is within a depth of 20 inches. In other places shale channers are within a depth of 10 inches.

Included with this soil in mapping are small areas of the moderately well drained, sodic Cavour soils in

swales. These soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Edgeley soil. Runoff is medium. Available water capacity is low. Organic matter content is high. Tilth is good. The shale bedrock restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling water erosion. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Grassed waterways in areas where runoff concentrates and a system of conservation tillage that leaves crop residue on the surface help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIe. The productivity index for spring wheat is 67. The range site is Silty.

33—Hecla loamy fine sand, 0 to 3 percent slopes. This deep, level and nearly level, moderately well drained soil is on flats and in swales on outwash plains and lake plains. Individual areas range from about 10 to more than 200 acres in size.

Typically, the surface soil is loamy fine sand about 20 inches thick. It is black in the upper part and very dark gray in the lower part. The next layer is very dark grayish brown, mottled fine sand about 12 inches thick. The next layer is very dark gray, mottled loamy fine sand about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled fine sand. In some places the dark surface layer extends to a depth of only 8 to 15 inches. In other places the surface layer is fine sandy loam, loamy sand, or fine sand.

Included with this soil in mapping are small areas of Embden, Hamar, and Ulen soils. These soils make up about 5 percent of the unit. The Embden soils occur as areas intermingled with areas of the Hecla soil. They contain more clay than the Hecla soil. The Hamar and Ulen soils are in swales and shallow depressions. The Hamar soils are poorly drained. The Ulen soils are somewhat poorly drained and have an accumulation of lime within a depth of 16 inches.

Permeability is rapid in the Hecla soil. Runoff is slow. Available water capacity is low. Organic matter content is moderately low. A seasonal high water table is at a depth of 3 to 6 feet. Tilth is fair.

Most areas are used for cultivated crops, but some are used for hay or pasture. Because of droughtiness, this soil is poorly suited to most types of small grain and to flax. It is best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing, maintaining organic matter content and fertility, and overcoming droughtiness. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, a cropping sequence that includes grasses and legumes, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where this soil is used for range, the important native forage plants are needleandthread, sand bluestem, and prairie sandreed. Intermediate wheatgrass, sweetclover, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and control soil blowing. Blowouts can occur along cattle trails and in areas where cattle congregate. They can be prevented by a planned grazing system that controls the pattern of livestock traffic.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IVe. The productivity index for spring wheat is 54. The range site is Sands.

34—Hecla-Hamar loamy fine sands, 0 to 3 percent slopes. These deep soils are on outwash plains and lake plains. The nearly level, moderately well drained Hecla soil is on flats and rises. The level and nearly level, poorly drained Hamar soil is in swales and depressions. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 50 to 70 percent Hecla soil and 30 to 50 percent Hamar soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Hecla soil has a loamy fine sand surface soil about 20 inches thick. The upper part is black, and the lower part is very dark gray. The next layer is very dark grayish brown, mottled fine sand about 12 inches thick. Below this is very dark gray, mottled loamy fine sand about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled fine sand. In some areas the dark surface layer extends to a depth of only 10 to 15 inches. In other areas the surface layer is fine sandy loam. In places the substratum is silt loam or silty clay loam below a depth of 40 inches.

Typically, the Hamar soil has a loamy fine sand surface soil about 12 inches thick. The upper part is black, and the lower part is very dark brown and is mottled. The substratum to a depth of about 60 inches is mottled fine sand. It is light brownish gray in the upper part and olive gray in the lower part.

Included with these soils in mapping are small areas of Rosewood, Tiffany, and Ulen soils. These included soils make up about 5 to 20 percent of the unit. The Rosewood and Ulen soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches. The Tiffany soils occur as areas intermingled with areas of the Hamar soil. They contain more clay in the subsoil than the Hamar soil.

Permeability is rapid in the Hecla and Hamar soils. Runoff is slow. Available water capacity is low. Organic matter content is moderately low in the Hecla soil and moderate in the Hamar soil. A seasonal high water table is at a depth of 3.0 to 6.0 feet in the Hecla soil and at a depth of 0.5 foot to 2.0 feet in the Hamar soil. Tilth is fair in both soils.

Most areas are used for cultivated crops, pasture, or hay. Some areas are used for range. Because of the droughtiness, these soils are poorly suited to most types of small grain. They are best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. In areas of the Hamar soil, spring planting may be delayed at times because of wetness. The main concerns in managing cultivated areas are controlling soil blowing, maintaining organic matter content and fertility, and overcoming droughtiness. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where these soils are used for range, the important native forage plants are prairie sandreed, big bluestem, and needleandthread. Intermediate wheatgrass, meadow fescue, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and control soil blowing. Blowouts can occur along cattle trails and in areas where cattle congregate. They can be prevented by a planned grazing system that controls the pattern of livestock traffic. Compaction, trampling, and root shearing are problems on the Hamar soil, especially if the range is grazed when the soil is wet. Grazing should be deferred during wet periods.

The Hecla soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. If drained, the Hamar soil is suited to all of the climatically adapted species. Undrained areas generally are unsuited to these uses. The wetness of the Hamar soil is a limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on the Hamar soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Hecla soil is IVe, and that of the Hamar soil is IVw. The productivity index of the unit for spring wheat ranges from 40 to 50, depending on the degree of drainage. The range site of

the Hecla soil is Sands, and that of the Hamar soil is Subirrigated.

35—Fordville loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on flats on outwash plains and terraces. Individual areas range from about 5 to more than 100 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsoil is very dark brown loam about 18 inches thick. The next layer is dark grayish brown sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is olive brown very gravelly sand.

Included with this soil in mapping are small areas of Arvilla and Renshaw soils intermingled with areas of the Fordville soil. These soils make up about 5 to 20 percent of the unit. The Arvilla soils have a surface layer of fine sandy loam. The Renshaw soils have a gravelly substratum at a depth of less than 20 inches.

Permeability is moderate in the upper part of the Fordville soil and rapid in the lower part. Runoff is slow. Available water capacity is moderate. Organic matter content is high. Tilth is good. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops or for pasture. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. It is best suited to rye and winter wheat, which make the best use of the early season moisture supply. The hazard of soil blowing or water erosion is slight. The main concern in managing cultivated areas is overcoming droughtiness. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where this soil is used for range, the important native forage plants are needleandthread, western wheatgrass, and porcupinegrass. Intermediate wheatgrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

This soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and the trees and shrubs are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIs. The productivity index for spring wheat is 59. The range site is Silty.

36—Hecla-Ulen complex, 0 to 3 percent slopes. These deep soils are on outwash plains and lake plains. The nearly level, moderately well drained Hecla soil is on flats and rises. The level, somewhat poorly drained, highly calcareous Ulen soil is on flats and in swales. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 40 to 65 percent Hecla soil and 35 to 60 percent Ulen soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Hecla soil has a loamy fine sand surface soil about 20 inches thick. The upper part is black, and the lower part is very dark gray. The next layer is very dark grayish brown, mottled fine sand about 12 inches thick. Below this is very dark gray, mottled loamy fine sand about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown, mottled fine sand. In some areas the dark surface layer extends to a depth of only 10 to 15 inches. In other areas the surface layer is fine sandy loam. In places the substratum is silt loam or silty clay loam below a depth of 40 inches.

Typically, the Ulen soil has a black fine sandy loam surface soil about 12 inches thick. The upper part of the subsoil is dark grayish brown and light brownish gray fine sandy loam about 4 inches thick. The next part is very dark grayish brown, mottled fine sandy loam about 4 inches thick. The lower part is light olive gray, mottled loamy fine sand. The substratum to a depth of about 60 inches is fine sand. It is olive gray in the upper part and dark grayish brown in the lower part. In places the substratum is silt loam or silty clay loam below a depth of 40 inches.

Included with these soils in mapping are small areas of the poorly drained Hamar, Rosewood, and Stirum soils. These included soils make up about 15 to 25 percent of the unit. The Hamar soils are in shallow depressions. The Rosewood and Stirum soils occur as areas intermingled with areas of the Ulen soil.

Permeability is rapid in the Hecla and Ulen soils. Runoff is slow. Available water capacity is low. Organic matter content is moderate. A seasonal high water table is at a depth of 3.0 to 6.0 feet in the Hecla soil and at a depth of 2.5 to 6.0 feet in the Ulen soil. Tilth is fair in both soils.

Most areas are used for cultivated crops, pasture, or hay. These soils are suited to small grain, flax, and sunflowers and to grass-legume hay. They are best

suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing, maintaining organic matter content, overcoming droughtiness, and maintaining fertility. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where these soils are used for range, the important native forage plants are big bluestem, needleandthread, and prairie sandreed. Tall wheatgrass, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and control soil blowing. Blowouts can occur along cattle trails and in areas where cattle congregate. They can be prevented by a planned grazing system that controls the pattern of livestock traffic.

These soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. They have no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Hecla soil is IVe, and that of the Ulen soil is IIIe. The productivity index of the unit for spring wheat is 52. The range site of the Hecla soil is Sands, and that of the Ulen soil is Limy Subirrigated.

37—Forman-Cavour loams, 1 to 3 percent slopes. These deep, nearly level, well drained soils are on till plains. The Forman soil is on rises. The sodic Cavour soil is in swales and on flats. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 50 to 75 percent Forman soil and 20 to 45 percent Cavour soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Forman soil is black loam about 6 inches thick. The subsoil is about 19 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The substratum to a depth of about 60 inches is dark grayish brown, mottled loam. In places the subsoil is loam throughout.

Typically, the surface layer of the Cavour soil is loam about 9 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsurface layer is dark gray loam about 3 inches thick. The subsoil is dense clay loam about 19 inches thick. It is very dark brown in the upper part, very dark grayish brown in the next part, and olive brown in the lower part. The substratum to a depth of about 60 inches is grayish brown loam. In places the subsoil is loam and is only moderately dense.

Included with these soils in mapping are small areas of Svea and Tonka soils. These included soils make up about 10 to 25 percent of the unit. The moderately well drained Svea soils are on flats. They have a surface layer that is dark to a depth of more than 16 inches. The poorly drained Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately slow in the Forman soil and very slow in the Cavour soil. Runoff is slow on both soils. Available water capacity is high in the Forman soil and moderate in the Cavour soil. Organic matter content is high in the Forman soil and moderate in the Cavour soil. Tilth is good in the Forman soil and fair in the Cavour soil. The dense, sodic subsoil of the Cavour soil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are maintaining tilth and controlling erosion. Because of moisture stress in most years, crop growth on the Cavour soil is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts in the Cavour soil adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the Cavour soil. The hazard of soil blowing or water erosion is slight. Conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the

important native forage plants are western wheatgrass, needleandthread, green needlegrass, and blue grama. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. The dense, sodic subsoil of the Cavour soil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas of the Cavour soil. Maintaining an adequate cover of the important plants or of other suitable plants helps to prevent denuding.

The Forman soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cavour soil is suited to only a few of the drought- and salt-tolerant species. Supplemental watering or irrigation helps to ensure the survival of seedlings. Individual trees and shrubs on the Cavour soil vary in height, density, and vigor. They are affected by the restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soils. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Forman soil is IIc, and that of the Cavour soil is IVs. The productivity index of the unit for spring wheat is 72. The range site of the Forman soil is Silty, and that of the Cavour soil is Claypan.

38—Miranda-Cavour loams, 1 to 3 percent slopes. These deep, nearly level soils are on till plains. The moderately well drained, moderately saline, sodic Miranda soil is on flats and in swales. The well drained, sodic Cavour soil is on flats and rises. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 60 to 90 percent Miranda soil and 15 to 30 percent Cavour soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Miranda soil is black loam about 4 inches thick. The subsoil is clay loam about 23 inches thick. It is very dark brown in the upper part, very dark grayish brown in the next part, and light olive brown in the lower part. The substratum to a depth of about 60 inches is olive clay loam.

Typically, the surface layer of the Cavour soil is loam about 9 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsurface layer is dark gray loam about 3 inches thick. The subsoil is dense clay loam about 19 inches thick. It is very dark brown in the upper part, very dark grayish brown in the next part, and olive brown in the lower part. The substratum to a depth of about 60 inches is grayish brown loam. In places the subsoil is loam and is only moderately dense.

Included with these soils in mapping are small areas of the moderately well drained, nonsodic Svea soils in swales. These included soils make up about 5 to 25 percent of the unit.

Permeability is very slow in the Miranda and Cavour soils. Runoff is slow. Available water capacity is moderate. Organic matter content is moderate. Tilth is fair. The surface is hard and crusted when dry and dispersed when wet. The dense, sodic subsoil restricts the depth to which roots can penetrate. Salts reduce the amount of water available to plants.

Most areas are used for pasture or range. These soils are best suited to these uses. Because of the dense, sodic subsoil and salts, they generally are unsuited to cultivated crops. The important native forage plants are western wheatgrass, blue grama, inland saltgrass, and green needlegrass. Crested wheatgrass, intermediate wheatgrass, tall wheatgrass, and alfalfa are suitable hay and pasture plants. The dense, sodic subsoil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important plants or of other suitable plants helps to prevent denuding. Stock water ponds constructed in areas of the Miranda soil sometimes contain salty water.

The Miranda soil generally is unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Cavour soil is suited only to a few of the drought- and salt-tolerant species. Supplemental watering or irrigation helps to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soils.

The land capability classification of the Miranda soil is VIs, and that of the Cavour soil is IVs. The productivity index of the unit for spring wheat is 0. The range site of the Miranda soil is Thin Claypan, and that of the Cavour soil is Claypan.

39—Hamar loamy fine sand. This deep, level, poorly drained soil is in depressions on outwash plains and lake plains. Individual areas range from about 10 to more than 300 acres in size.

Typically, the surface soil is loamy fine sand about 12 inches thick. It is black in the upper part and very dark brown and mottled in the lower part. The

substratum to a depth of about 60 inches is mottled fine sand. It is light brownish gray in the upper part and olive gray in the lower part.

Included with this soil in mapping are small areas of Hecla, Ulen, and Wyndmere soils. These soils make up about 5 to 20 percent of the unit. The moderately well drained Hecla soils are on rises. The Ulen and Wyndmere soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches.

Permeability is rapid in the Hamar soil. Runoff is slow. Available water capacity is low. Organic matter content is moderate. A seasonal high water table is at a depth of 0.5 foot to 2.0 feet. Tilth is poor.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, and sunflowers and to grass-legume hay. In wet years it is best suited to late-seeded crops. The main concerns in managing cultivated areas are overcoming wetness and controlling soil blowing. The hazard of soil blowing is severe, but the hazard of water erosion is slight. Excess surface water is removed from most areas by natural runoff, deep seepage, or a system of constructed drains. Field windbreaks, stripcropping, cover crops, buffer strips, a system of conservation tillage that leaves crop residue on the surface, and a cropping system that includes grasses and legumes in the rotation help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem, indiangrass, and switchgrass. In drained areas creeping foxtail, meadow fescue, and alsike clover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing. Compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods. The wetness hinders haying in some years.

If drained, this soil is suited to all of the trees and shrubs commonly grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IVw. The productivity index for spring wheat is 50. The range site is Subirrigated.

40—Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes. These deep soils are on till plains and moraines. The level and nearly level, somewhat poorly drained, highly calcareous Hamerly soil is on rises and flats. The level, poorly drained Tonka soil is in shallow depressions. The level, very poorly drained Parnell soil is in deep depressions. The Tonka and Parnell soils are subject to ponding. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 40 to 55 percent Hamerly soil, 20 to 30 percent Tonka soil, and 15 to 35 percent Parnell soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Hamerly soil is black loam about 7 inches thick. The subsoil is light olive brown loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, mottled loam. In places the substratum is grayish brown in the upper part.

Typically, the Tonka soil has a black silt loam surface soil about 13 inches thick. The subsurface layer is very dark gray, mottled silt loam about 5 inches thick. The subsoil is about 16 inches thick. It is very dark gray silty clay in the upper part and dark gray, mottled clay in the lower part. The next layer is olive gray, mottled silty clay loam about 9 inches thick. The substratum to a depth of about 60 inches is olive, mottled silty clay loam.

Typically, the surface layer of the Parnell soil is black silty clay loam about 11 inches thick. The lower part is mottled. The subsoil is black silty clay about 30 inches thick. The next layer to a depth of about 60 inches is very dark gray, mottled clay. In places the subsoil is calcareous within a depth of 10 inches.

Included with these soils in mapping are small areas of Barnes, Buse, and Svea soils. These included soils make up about 5 to 25 percent of the unit. The well drained Barnes soils are on rises. The well drained Buse soils are on knolls and knobs. The moderately well drained Svea soils are in swales.

Permeability is moderately slow in the Hamerly soil and slow in the Parnell and Tonka soils. Runoff is slow on the Hamerly soil and ponded on the Tonka and Parnell soils. Available water capacity is high in all three soils. Organic matter content is high in the Hamerly and Tonka soils and very high in the Parnell soil. A seasonal high water table is at a depth of 2.0 to 4.0 feet in the Hamerly soil, is 2.0 feet above to 2.0 feet below the surface of the Parnell soil, and is 0.5 foot above to 1.0 foot below the surface of the Tonka soil. Tilth is good in

the Hamerly and Tonka soils and fair in the Parnell soil.

Most areas are used for cultivated crops. These soils are poorly suited to small grain, flax, corn, and sunflowers. They are better suited to pasture and hay. The main concerns in managing cultivated areas are overcoming wetness and controlling soil blowing. In undrained areas, tillage, seeding, or harvest operations are usually delayed or prevented and crops are harvested in only 2 to 5 years out of 10. Drainage of the Parnell and Tonka soils increases the suitability for crops. Locating suitable drainage outlets is difficult. As a result, few areas are adequately drained. The hazard of soil blowing is moderate on the Hamerly soil and slight on the Parnell and Tonka soils. The hazard of water erosion is slight on all three soils. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing on the Hamerly soil.

Areas of the Tonka and Parnell soils and the ponded water provide feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural wetness and preventing siltation.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, porcupinegrass, needleandthread, slim sedge, wooly sedge, slough sedge, and rivergrass. Creeping foxtail, reed canarygrass, smooth brome, and sweetclover are suitable hay and pasture plants. Compaction, trampling, and root shearing are problems on the Parnell and Tonka soils, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods. Soil blowing on the Hamerly soil is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

The Hamerly soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. If drained, the Tonka and Parnell soils are suited to these uses. Undrained areas generally are unsuited to these uses. The wetness of the Tonka and Parnell soils is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on these soils are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Hamerly soil is IIe, that of the Tonka soil is IIw, and that of the Parnell soil is IIIw. The productivity index of the unit for spring wheat ranges from 50 to 74, depending on the degree of drainage in areas of the Parnell and Tonka soils. The range site of the Hamerly soil is Limy Subirrigated, that of the Tonka soil is Wet Meadow, and that of the Parnell soil is Wetland.

41—Colvin silt loam, saline. This deep, level, poorly drained, highly calcareous, moderately saline soil is on flats on lake plains and till plains and in drainageways on outwash plains. Individual areas range from about 10 to more than 200 acres in size.

Typically, the surface layer is black silt loam about 7 inches thick. It has filaments of salts. The next layer is very dark gray silt loam about 14 inches thick. The subsoil is olive gray silty clay loam about 15 inches thick. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In places the subsoil is olive brown.

Included with this soil in mapping are small areas of Harriet, Parnell, Ryan, Stirum, and Tonka soils and small areas of a poorly drained soil that has a substratum of gravelly sand or sand. These soils make up about 10 to 25 percent of the unit. The Harriet, Ryan, and Stirum soils and the poorly drained soil occur as areas intermingled with areas of the Colvin soil. The Harriet, Ryan, and Stirum soils have a dense, sodic subsoil. The Parnell and Tonka soils are in depressions. They have an accumulation of clay in the subsoil. The Parnell soils are very poorly drained, and the Tonka soils are poorly drained.

Permeability is moderately slow in the Colvin soil. Runoff is slow. Available water capacity is moderate. Organic matter content is high. A seasonal high water table is within a depth of 2 feet. Tilth is good. Salts reduce the amount of water available to plants.

Most areas are used for range, hay, or wetland wildlife habitat. This soil is best suited to these uses and to salt-tolerant crops. In drained areas it is poorly suited to small grain, flax, and sunflowers because of salinity. The main concerns in managing cultivated areas are overcoming wetness, controlling soil blowing, and reducing salinity. Locating suitable drainage outlets generally is difficult. As a result, few areas are drained. In undrained areas, tillage, seeding, or harvest operations are usually prevented or delayed by wetness and crops are harvested in only about 3 to 5 years out of 10. Salinity has increased in some drained areas. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. A permanent cover of crops or

crop residue helps to control the accumulation of salts in the surface layer by reducing the evaporation rate at the surface. Growing salt-tolerant crops, such as barley, helps to overcome the salinity.

This soil provides feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat are maintaining the natural wetness and preventing siltation.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, alkali cordgrass, and inland saltgrass. Alkali sacaton and sweetclover are suitable hay and pasture plants. The high content of salts and the reduced amount of available water are limitations, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the salt-tolerant plants helps to control soil blowing and to leach salts from the root zone. Stock water ponds constructed in areas of this soil frequently contain salty water.

This soil is suited to only a few of the most salt-tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the reduced amount of available water caused by the salts in the soil. Reducing the evaporation rate at the surface improves seedling survival. When a bare soil surface dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIs. The productivity index for spring wheat ranges from 15 to 40, depending on the degree of drainage and of salinity. The range site is Saline Lowland.

42—Hamerly-Wyard loams, 0 to 3 percent slopes. These deep, level and nearly level, somewhat poorly drained soils are on till plains. The highly calcareous Hamerly soil is on rises. The Wyard soil is in swales. Individual areas of this unit range from about 10 to more than 300 acres in size. They are about 50 to 65 percent Hamerly soil and 25 to 35 percent Wyard soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Hamerly soil is black loam about 7 inches thick. The subsoil is light olive brown loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, mottled loam. In some places the upper part of the substratum is grayish brown. In other places the substratum is gray.

Typically, the Wyard soil has a black loam surface soil about 19 inches thick. The subsoil is about 15 inches thick. It is dark grayish brown, mottled silt loam in the upper part and light yellowish brown, mottled loam in the lower part. The substratum to a depth of about 60 inches is grayish brown, mottled loam.

Included with these soils in mapping are small areas of Barnes, Parnell, Svea, and Tonka soils. These included soils make up about 5 to 25 percent of the unit. The well drained Barnes soils are on rises. The very poorly drained Parnell and poorly drained Tonka soils are in depressions. The moderately well drained Svea soils occur as areas intermingled with areas of the Wyard soil.

Permeability is moderately slow in the Hamerly soil and moderate in the Wyard soil. Runoff is slow on both soils. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 2 to 4 feet in the Hamerly soil and at a depth of 1 to 3 feet in the Wyard soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to pasture. The main concerns in managing cultivated areas are controlling soil blowing and overcoming wetness. The hazard of soil blowing is moderate on the Hamerly soil and slight on the Wyard soil. The hazard of water erosion is slight on both soils. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Surface drainage of the Wyard soil increases the suitability for crops, but locating suitable drainage outlets is difficult.

In areas where these soils are used for range, the important native forage plants are big bluestem, green needlegrass, little bluestem, and western wheatgrass. Creeping foxtail, reed canarygrass, smooth brome, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard on the Hamerly soil, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

These soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Hamerly soil is IIe, and that of the Wyard soil is IIw. The productivity index of the unit for spring wheat is 85. The range site

of the Hamerly soil is Limy Subirrigated, and that of the Wyard soil is Overflow.

43—Exline silt loam. This deep, level, somewhat poorly drained, moderately saline, sodic soil is on flats and in swales on lake plains. Individual areas range from about 5 to more than 100 acres in size.

Typically, the surface layer is black silt loam about 8 inches thick. The subsoil is dense and is about 17 inches thick. In sequence downward, it is black silty clay, very dark brown silty clay loam, very dark gray silty clay loam, and dark grayish brown silty clay loam. The substratum to a depth of about 60 inches is silty clay loam. It is grayish brown in the upper part and light olive brown in the lower part. In some places the surface layer is silty clay loam. In other places the subsoil is only moderately dense.

Included with this soil in mapping are small areas of Overly soils on rises. These soils make up about 10 percent of the unit. They do not have a sodic subsoil.

Permeability is very slow in the Exline soil. Runoff also is very slow. Available water capacity and organic matter content are moderate. A seasonal high water table is at a depth of 2.5 to 4.0 feet. The surface layer is hard and crusted when dry and dispersed when wet. The dense, sodic subsoil restricts the depth to which roots can penetrate. Salts reduce the amount of water available to plants.

Most areas are used for range or pasture, but some are used for cultivated crops. This soil is best suited to range, pasture, and hay. Because of salinity and alkalinity, it generally is unsuited to cultivated crops and to trees and shrubs. The important native forage plants are western wheatgrass, inland saltgrass, and blue grama. Tall wheatgrass and sweetclover are suitable hay and pasture plants. The dense, sodic subsoil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important plants or of other suitable plants helps to prevent denuding. Stock water ponds constructed in areas of this soil frequently contain salty water.

This soil generally is unsuited to the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs can be grown for esthetic purposes or to enhance wildlife habitat if special management, such as hand or scalp planting, is applied.

The land capability classification is VIs. The productivity index for spring wheat is 0. The range site is Thin Claypan.

44—Harriet loam. This deep, level, poorly drained, moderately saline, sodic soil is on flats on flood plains. It is subject to flooding. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is very dark gray loam about 2 inches thick. The subsoil is about 27 inches thick. In sequence downward, it is black silty clay, very dark gray silty clay, very dark gray silty clay loam, and olive gray clay. The substratum to a depth of about 60 inches is mottled clay. It is olive in the upper part and olive gray in the lower part.

Included with this soil in mapping are small areas of Miranda soils on rises. These soils make up about 5 to 15 percent of the unit. They are better drained than the Harriet soil.

Permeability is very slow in the Harriet soil. Runoff is slow. Available water capacity and organic matter content are moderate. A seasonal high water table is within a depth of 1 foot. The dense, sodic subsoil restricts the depth to which roots can penetrate. Salts reduce the amount of water available to plants.

Most areas are used for range. This soil is best suited to range and to hay and pasture. Because of salinity, alkalinity, and wetness, it generally is unsuited to cultivated crops and to trees and shrubs. The important native forage plants are Nuttall alkaligrass, inland saltgrass, and western wheatgrass. Tall wheatgrass, western wheatgrass, and alsike clover are suitable hay and pasture plants. The high salt content, a reduced supply of available water, compaction, trampling, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. They can be overcome by maintaining an adequate cover of the important plants or of other suitable plants and by deferring grazing during wet periods. Stock water ponds constructed in areas of this soil frequently contain salty water.

The land capability classification is VIs. The productivity index for spring wheat is 0. The range site is Saline Lowland.

46—Ludden clay. This deep, level, poorly drained soil is on flats on flood plains. It is subject to flooding. Individual areas range from about 20 to more than 200 acres in size.

Typically, the surface soil is black clay about 14 inches thick. The subsoil also is black clay. It is about 16 inches thick. The substratum to a depth of about 60 inches is clay. It is dark gray in the upper part and very dark gray in the lower part. In some places the surface layer and subsoil contain salts. In other places the soil has less clay and more silt throughout.

Included with this soil in mapping are small areas of sodic Ryan soils. These soils make up about 5 to 10

percent of the unit. They occur as areas intermingled with areas of the Ludden soil.

Permeability is slow in the Ludden soil. Runoff is very slow. Available water capacity is high. Organic matter content also is high. A seasonal high water table is within a depth of 2 feet. Tilth is poor.

Most areas are used for cultivated crops, but some are used for pasture or hay. This soil is suited to small grain, corn, and flax and to grass-legume hay. The main concerns in managing cultivated areas are maintaining tilth and fertility, controlling soil blowing, and overcoming wetness. In undrained areas tillage, seeding, or harvest operations are usually delayed or sometimes prevented by wetness. Surface drainage increases the suitability for crops. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth.

In areas where this soil is used for range, the important native forage plants are big bluestem, green needlegrass, western wheatgrass, and prairie cordgrass. Creeping foxtail, meadow fescue, meadow foxtail, and alsike clover are suitable hay and pasture plants. Trampling, compaction, and root shearing are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIw. The productivity index for spring wheat is 60. The range site is Overflow.

47—La Prairie loam, channeled. This deep, level, moderately well drained soil is on flood plains. It is subject to flooding. Individual areas range from about 20 to more than 150 acres in size. They are dissected into small, irregularly shaped areas by meandering channels.

Typically, the surface soil is black loam about 18 inches thick. The subsoil is very dark brown loam about 4 inches thick. The next layer is black silt loam about 7 inches thick. The substratum to a depth of about 60 inches is dark grayish brown loam. In some places the subsoil is fine sandy loam.

Included with this soil in mapping are small areas of sodic Cresbard soils. These soils are intermingled with areas of the La Prairie soil. They make up about 5 percent of the unit.

Permeability is moderate in the La Prairie soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 3.5 to 6.0 feet.

Most areas are used for pasture or range, but a few areas are used for cultivated crops. Because of the flooding, the meandering channels, and the small size of individual tillable areas, this soil generally is unsuited to cultivated crops and to trees and shrubs. It is best suited to pasture and range. The important native forage plants are big bluestem, western wheatgrass, and green needlegrass. Big bluestem, smooth brome, intermediate wheatgrass, and alfalfa are suitable hay and pasture plants. Scouring is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control scouring during periods of flooding.

The land capability classification is VIw. The productivity index for spring wheat is 0. The range site is Overflow.

48—La Prairie loam. This deep, level, moderately well drained soil is on flood plains, terraces, and alluvial fans. It is subject to flooding. Individual areas range from about 20 to more than 100 acres in size.

Typically, the surface soil is black loam about 18 inches thick. The subsoil is very dark brown loam about 4 inches thick. The next layer is black silt loam about 7 inches thick. The substratum to a depth of about 60 inches is dark grayish brown loam. In places the subsoil is fine sandy loam. In areas along the base of the Coteau, the soil is not subject to flooding.

Included with this soil in mapping are small areas of sodic Cresbard soils. These soils are intermingled with areas of the La Prairie soil. They make up about 5 percent of the unit.

Permeability is moderate in the La Prairie soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a

depth of 3.5 to 6.0 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is maintaining tilth and fertility. Incorporating organic material into the surface layer helps to maintain or improve tilth and fertility. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem, western wheatgrass, and green needlegrass. Intermediate wheatgrass, smooth brome, big bluestem, and alfalfa are suitable hay and pasture plants. No major problems affect the use of this soil for range or pasture.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIc. The productivity index for spring wheat is 98. The range site is Silty.

49—Lamoure silt loam. This deep, level, poorly drained soil is in drainage channels and on flood plains. It is subject to flooding. Individual areas range from about 5 to more than 300 acres in size.

Typically, the surface soil is very dark gray and is about 31 inches thick. It is silt loam in the upper part and mottled silty clay loam in the lower part. The next layer is black silty clay loam about 5 inches thick. The substratum to a depth of about 60 inches is olive gray, mottled silty clay loam. In some places the soil is clay throughout. In other places the surface layer and subsoil contain salts.

Included with this soil in mapping are small areas of Ryan soils. Also included are some areas of very poorly drained soils in oxbows and some small areas of saline soils. The Ryan soils occur as areas intermingled with areas of the Lamoure soil. They have a dense, sodic subsoil. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Lamoure soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is within a depth of 2 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is poorly suited to small grain, sunflowers, and flax. It is better suited to hay, pasture, and wildlife habitat. The main management concerns in cultivated areas are overcoming wetness and flooding and controlling soil blowing. A surface drainage system increases the suitability for crops, but the degree of salinity may increase in drained areas. Seeding may be delayed in some years as a result of flooding. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks, annual buffer strips, and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to maintain tilth and to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are big bluestem and switchgrass. Creeping foxtail, meadow fescue, and alsike clover are suitable hay and pasture plants. Scouring during periods of flooding is a hazard, especially if the range or pasture is overgrazed. It can be controlled by maintaining an adequate cover of the important plants or of other suitable plants. Compaction, trampling, and root shearing also are problems, especially if the range or pasture is grazed when the soil is wet. Grazing should be deferred during wet periods.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIw. The productivity index for spring wheat ranges from 40 to 73, depending on the degree of drainage. The range site is Subirrigated.

50—Wyndmere-Tiffany fine sandy loams. These deep, level soils are on lake plains and outwash plains. The somewhat poorly drained, highly calcareous Wyndmere soil is on rises and flats. The poorly drained Tiffany soil is in swales and depressions. Individual areas of this unit range from about 20 to more than 180 acres in size. They are about 45 to 70 percent Wyndmere soil and 30 to 50 percent Tiffany soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Wyndmere soil is black fine sandy loam about 8 inches thick. The subsoil is light brownish gray fine sandy loam about 18 inches thick. The substratum extends to a depth of about 60 inches. It is olive brown, mottled fine sandy loam in the upper part; grayish brown, mottled fine sand in the next part; and grayish brown, mottled loam in the lower part.

Typically, the Tiffany soil has a fine sandy loam surface soil about 18 inches thick. The upper part is black, and the lower part is very dark gray and is mottled. The next layer is dark grayish brown, mottled fine sandy loam about 12 inches thick. The substratum to a depth of about 60 inches is dark grayish brown and is mottled. It is fine sandy loam in the upper part and loamy fine sand in the lower part.

Included with these soils in mapping are small areas of Tonka soils in depressions. Also included are areas west of Ellendale where depth to the water table results in a scarcity of moisture and lower crop yields. The Tonka soils have a subsurface layer and an accumulation of clay in the subsoil. Included soils make up about 10 to 25 percent of the unit.

Permeability is moderately rapid in the Wyndmere soil and moderate in the Tiffany soil. Runoff is slow on the Wyndmere soil and ponded on the Tiffany soil. Available water capacity is moderate in both soils. Organic matter content is high. A seasonal high water table is at a depth of 2 to 5 feet in the Wyndmere soil and is 1 foot above to 3 feet below the surface of the Tiffany soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are suited to small grain, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling soil blowing and overcoming wetness. The hazard of soil blowing is severe, but the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Surface drainage of the Tiffany soil increases the suitability for crops.

In areas where these soils are used for range, the important native forage plants are big bluestem, green needlegrass, and little bluestem. Creeping foxtail, smooth brome, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

These soils are suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. They have no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Wyndmere soil is IIIe, and that of the Tiffany soil is IIIw. The productivity index of the unit for spring wheat is 71. The range site of the Wyndmere soil is Limy Subirrigated, and that of the Tiffany soil is Subirrigated.

51—Kratka-Letcher fine sandy loams, 0 to 2 percent slopes. These deep, level and nearly level soils are on till plains. The poorly drained Kratka soil is in swales and depressions. The somewhat poorly drained, sodic Letcher soil is on flats and rises. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 55 to 75 percent Kratka soil and 20 to 40 percent Letcher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Kratka soil is black fine sandy loam about 8 inches thick. The subsoil is dark grayish brown and is mottled. It is about 26 inches thick. It is loamy fine sand in the upper part and fine sand in the lower part. The next layer is dark gray clay loam about 3 inches thick. The upper part of the substratum is grayish brown, mottled loam. The lower part to a depth of about 60 inches is light brownish gray, mottled fine sandy loam.

Typically, the surface layer of the Letcher soil is black fine sandy loam about 8 inches thick. The subsurface layer is very dark gray sandy loam about 1 inch thick. The subsoil is about 33 inches thick. In sequence downward, it is dark brown, mottled, dense sandy loam; dark grayish brown, mottled sandy loam; grayish brown loam; and olive gray loam. The substratum to a depth of about 60 inches is olive brown, mottled fine sandy loam. In places salts are within a depth of 16 inches.

Included with these soils in mapping are small areas of very poorly drained soils in depressions. These included soils make up about 5 to 25 percent of the unit.

Permeability is moderately rapid in the upper part of the Kratka soil and moderately slow in the lower part. It is slow in the upper part of the Letcher soil and moderately rapid in the lower part. Runoff is slow on both soils. Available water capacity and organic matter content are moderate. A seasonal high water table is at a depth of 0.5 foot to 3.0 feet in the Kratka soil and at a depth of 3.5 to 6.0 feet in the Letcher soil. Tilth is good in the Kratka soil and fair in the Letcher soil. The

dense, sodic subsoil of the Letcher soil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, and sunflowers and to grass-legume hay. They are best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing and improving root penetration in the Letcher soil. Because of moisture stress in most years, crop growth on the Letcher soil is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the subsoil. The hazard of soil blowing is severe, but the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Little benefit is derived from fallowing because of the moderate available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where these soils are used for range, the important native forage plants are big bluestem, switchgrass, needleandthread, and western wheatgrass. Intermediate wheatgrass, alfalfa, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

If drained, the Kratka soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The Letcher soil is suited to only a few of the drought- and salt-tolerant, climatically adapted species. Supplemental watering or irrigation helps to ensure the survival of seedlings on the Letcher soils. Individual trees and shrubs on the Letcher soil vary in height, density, and vigor. They are affected by the restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Kratka soil is IIIw, and that of the Letcher soil is IVs. The productivity index of the unit for spring wheat is 50. The range site of the Kratka soil is Subirrigated, and that of the Letcher soil is Sandy Claypan.

52C—Brantford-Coe loams, 3 to 9 percent slopes. These deep, undulating and gently rolling soils are on outwash plains and terraces. The well drained Brantford soil is on flats. The excessively drained Coe soil is on rises. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 55 to 75 percent Brantford soil and 25 to 45 percent Coe soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Brantford soil is black loam about 8 inches thick. The subsoil is very dark grayish brown loam about 7 inches thick. The upper part of the substratum is dark grayish brown gravelly sand. The lower part to a depth of about 60 inches is dark brown and pale brown very gravelly coarse sand. In places the slope is less than 3 percent.

Typically, the surface layer of the Coe soil is black loam about 6 inches thick. The substratum extends to a depth of about 60 inches. It is dark grayish brown extremely gravelly loamy coarse sand in the upper part, grayish brown very gravelly loamy coarse sand in the next part, and grayish brown gravelly loamy coarse sand in the lower part.

Included with these soils in mapping are small areas of the moderately well drained, sodic Cavour soils. These included soils make up about 5 to 20 percent of the unit. They occur as areas intermingled with areas of the Brantford soil.

Permeability is moderate in the upper part of the Brantford and Coe soils and very rapid in the lower part. Runoff is medium on both soils. Available water capacity is low. Organic matter content is high. Tilth is good. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are poorly suited to most types of small grain and to flax, corn, and sunflowers but are suited to grass-legume hay. They are best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concerns in managing cultivated areas are overcoming droughtiness and controlling water erosion. The hazard of soil blowing is slight, but the hazard of water erosion is severe. Grassed waterways in areas where runoff concentrates and a system of conservation tillage that leaves crop residue on the surface help to control erosion.

Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Crested wheatgrass, intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

The Brantford soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Coe soil generally is unsuited to these uses. The soils are droughty, and the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Brantford soil is IVe, and that of the Coe soil is VIs. The productivity index of the unit for spring wheat is 21. The range site of the Brantford soil is Shallow to Gravel, and that of the Coe soil is Very Shallow.

53—Brantford-Vang loams, 1 to 3 percent slopes. These deep, nearly level, well drained soils are on flats on outwash plains and terraces. Individual areas range from about 5 to more than 100 acres in size. They are about 45 to 65 percent Brantford soil and 30 to 45 percent Vang soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Brantford soil is black loam about 8 inches thick. The subsoil is very dark grayish brown loam about 7 inches thick. The upper part of the substratum is dark grayish brown gravelly sand. The lower part to a depth of about 60 inches is dark brown and pale brown very gravelly coarse sand.

Typically, the Vang soil has a black loam surface soil about 14 inches thick. The subsoil is loam about 18 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is dark grayish brown very gravelly loamy coarse sand.

Included with these soils in mapping are small areas of Cavour and Svea soils. These included soils make up about 5 to 25 percent of the unit. They occur as areas intermingled with areas of the Brantford soil. The Cavour soils have a dense, sodic subsoil. The Svea soils have a nongravelly subsoil and substratum.

Permeability is moderate in the upper part of the Brantford and Vang soils and very rapid in the lower part. Runoff is slow. Available water capacity is low in the Brantford soil and moderate in the Vang soil. Organic matter content is high in both soils. Tilth is good. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, corn, and sunflowers and to grass-legume hay. They are best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concern in managing cultivated areas is overcoming droughtiness. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where these soils are used for range, the important native forage plants are needleandthread, blue grama, and green needlegrass. Western wheatgrass, intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

These soils are suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. They are droughty, and the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity of the Brantford soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Brantford soil is IIIs, and that of the Vang soil is IIs. The productivity index of the unit for spring wheat is 53. The range site of the Brantford soil is Shallow to Gravel, and that of the Vang soil is Silty.

54—Maddock fine sandy loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on

flats on lake plains. Individual areas range from about 10 to more than 200 acres in size.

Typically, the surface layer is black fine sandy loam about 9 inches thick. The subsoil is dark yellowish brown and is about 18 inches thick. It is loamy fine sand in the upper part and fine sand in the lower part. The substratum to a depth of about 60 inches is sand. It is olive brown in the upper part and light olive brown in the lower part. In some places the surface layer is loamy fine sand. In other places, the subsoil is coarse sandy loam and the substratum is gravelly. In a few areas the substratum is mottled.

Included with this soil in mapping are small areas of Clontarf and Hamar soils. These soils make up about 5 to 15 percent of the unit. The Clontarf soils occur as areas intermingled with areas of the Maddock soil. They are fine sandy loam to a depth of about 28 inches. The poorly drained Hamar soils are in shallow depressions.

Permeability is rapid in the Maddock soil. Runoff is slow. Available water capacity is low. Organic matter content is moderate. Tilth is good.

Most areas are used for cultivated crops, pasture, hay, or range. Because of droughtiness, this soil is poorly suited to most types of small grain and to flax and sunflowers. It is best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing and overcoming droughtiness. The hazard of soil blowing is severe, but the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where this soil is used for range, the important native forage plants are needleandthread, prairie sandreed, and green needlegrass. Intermediate wheatgrass, sweetclover, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and control soil blowing. Blowouts can occur along cattle trails and in areas where cattle congregate. They can be prevented by a planned grazing system that controls the pattern of livestock traffic.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is somewhat droughty and the trees and shrubs commonly are affected by moisture stress, particularly during the establishment period. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIe. The productivity index for spring wheat is 57. The range site is Sandy.

56—Overly silt loam. This deep, level, moderately well drained soil is on flats on lake plains. Individual areas range from about 10 to more than 200 acres in size.

Typically, the surface soil is black and is about 13 inches thick. It is silt loam in the upper part and silty clay loam in the lower part. The subsoil is silt loam about 29 inches thick. It is very dark grayish brown and mottled in the upper part, grayish brown and mottled in the next part, and light brownish gray in the lower part. The substratum to a depth of about 60 inches is olive yellow, mottled silt loam. In some places the substratum has thin strata of fine sandy loam or loamy sand below a depth of 40 inches. In other places the dark surface soil extends to a depth of only 7 to 15 inches.

Included with this soil in mapping are small areas of Aberdeen and Glyndon soils. These soils make up about 5 to 15 percent of the unit. The sodic Aberdeen soils occur as areas intermingled with areas of the Overly soil. The Glyndon soils are in swales. They have an accumulation of lime within a depth of 16 inches.

Permeability is moderately slow in the Overly soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is maintaining fertility and tilth. Incorporating organic material into the surface layer improves tilth and fertility. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control

erosion. Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, Russian wildrye, and alfalfa are suitable hay and pasture plants. No major problems affect the use of this soil for range or pasture.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIc. The productivity index for spring wheat is 96. The range site is Silty.

57—Ryan-Ludden complex. These deep, level, poorly drained soils are on flood plains. The moderately saline, sodic Ryan soil is in swales. The slightly saline to moderately saline Ludden soil is on flats. Both soils are subject to flooding. Individual areas range from about 5 to more than 1,000 acres in size. They are about 55 to 80 percent Ryan soil and 20 to 40 percent Ludden soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Ryan soil is black silty clay about 2 inches thick. The subsoil is black silty clay about 34 inches thick. The substratum to a depth of about 60 inches is very dark gray silty clay. In places masses of salts are in the upper part of the subsoil.

Typically, the Ludden soil has a black clay surface soil about 14 inches thick. The subsoil is black clay about 16 inches thick. The substratum to a depth of about 60 inches is clay. It is dark gray in the upper part and very dark gray in the lower part.

Included with these soils in mapping are small areas of Colvin and Lamoure soils and nonsaline Ludden soils. These included soils make up about 5 to 25 percent of the unit. The nonsaline Ludden soils occur as areas intermingled with areas of the Ryan and the saline Ludden soils. The Colvin soils have a layer of lime accumulation within a depth of 16 inches. The Lamoure soils have less clay than the Ludden and Ryan soils.

Permeability is very slow in the Ryan soil and slow in the Ludden soil. Runoff is very slow on both soils. Available water capacity is moderate in the Ryan soil and low in the Ludden soil. Organic matter content is high in both soils. A seasonal high water table is within a depth of 1 foot in the Ryan soil and within a depth of 2 feet in the Ludden soil. The dense, sodic subsoil of the Ryan soil restricts the depth to which roots can penetrate. Salts in both soils reduce the amount of water available to plants.

Most areas are used for cultivated crops. These soils are best suited to pasture, range, and hay. Because of the dense, sodic subsoil and the salts, they generally are unsuited to cultivated crops. In areas where the soils are used for range, the important native forage plants are western wheatgrass, inland saltgrass, and blue grama. Tall wheatgrass, western wheatgrass, and sweetclover are suitable hay and pasture plants. The dense, sodic subsoil that restricts root penetration and the salts that reduce the available water capacity are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important plants or of other suitable plants helps to prevent denuding. Stock water ponds constructed in areas of these soils frequently contain salty water.

These soils are suited to only a few of the drought- and salt-tolerant climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Supplemental watering or irrigation helps to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the restricted root development in the dense, sodic subsoil of the Ryan soil and by the reduced amount of available water caused by the salts in the soils. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Ryan soil is VIs, and that of the Ludden soil is IIIs. The productivity index of the unit for spring wheat is 0. The range site of the Ryan soil is Thin Claypan, and that of the Ludden soil is Saline Lowland.

58—Renshaw loam. This deep, level, somewhat excessively drained soil is on flats on outwash plains and terraces. Individual areas range from about 3 to more than 100 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsoil is very dark grayish brown loam about 7 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown gravelly loamy sand. In places the depth to gravel is less than 14 inches.

Included with this soil in mapping are small areas of Fordville and Spottswood soils. These soils make up

about 5 to 20 percent of the unit. They are in swales. They are more than 20 inches deep over the gravelly substratum.

Permeability is moderate in the upper part of the Renshaw soil and very rapid in the lower part. Runoff is slow. Available water capacity is low. Organic matter content is moderate. Tilth is good. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops or for pasture. This soil is suited to small grain, flax, corn, and sunflowers and to grass-legume hay. It is best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concern in managing cultivated areas is overcoming droughtiness. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where this soil is used for range, the important native forage plants are green needlegrass, western wheatgrass, and needleandthread. Intermediate wheatgrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

This soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It is droughty, and the trees and shrubs are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIIs. The productivity index for spring wheat is 32. The range site is Shallow to Gravel.

59—Pits. This map unit occurs as areas from which the soil material has been removed and the underlying sand and gravel mined. Many of the areas are abandoned and are idle, and most support little or no vegetation. The areas range from about 3 to more than 80 acres in size.

This map unit generally is unsuited to agricultural uses unless the areas are leveled, topdressed with suitable material, or otherwise reclaimed. In unreclaimed areas planting climatically suited trees and shrubs can enhance wildlife habitat or increase the esthetic value. The suitability of species varies in different areas.

No land capability classification or range site is assigned. The productivity index for spring wheat is 0.

60B—Renshaw-Sioux loams, 1 to 6 percent slopes. These deep, nearly level and undulating soils are on outwash plains and terraces. The somewhat excessively drained Renshaw soil is on flats. The excessively drained Sioux soil is on rises. Individual areas of this unit range from about 3 to more than 100 acres in size. They are about 60 to 75 percent Renshaw soil and 20 to 35 percent Sioux soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Renshaw soil is black loam about 8 inches thick. The subsoil is very dark grayish brown loam about 7 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown gravelly loamy sand.

Typically, the surface layer of the Sioux soil is black loam about 8 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown very gravelly coarse sand. In places the soil has a thin subsoil.

Included with these soils in mapping are small areas of Fordville and Spottswood soils in swales. These included soils make up about 5 to 20 percent of the unit. They are more than 20 inches deep over the gravelly substratum.

Permeability is moderate in the upper part of the Renshaw soil and very rapid in the lower part. It is very rapid in the Sioux soil. Runoff is slow on both soils. Available water capacity is low. Organic matter content is moderate. Tilth is fair. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops or for pasture. These soils are poorly suited to most types of small grain and to flax, corn, and sunflowers. They are best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concern in managing cultivated areas is overcoming droughtiness. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where these soils are used for range, the important native forage plants are needleandthread,

blue grama, and western wheatgrass. Intermediate wheatgrass, western wheatgrass, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

The Renshaw soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Sioux soil generally is unsuited to these uses. The soils are droughty, and the trees and shrubs are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Renshaw soil is IIIe, and that of the Sioux soil is VIs. The productivity index of the unit for spring wheat is 35. The range site of the Renshaw soil is Shallow to Gravel, and that of the Sioux soil is Very Shallow.

61D—Sioux loam, 1 to 15 percent slopes. This deep, nearly level to strongly sloping, excessively drained soil is on flats and knolls on outwash plains and terraces. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown very gravelly coarse sand. In some places the soil has a thin subsoil. In other places the surface is stony. In a few places along the James River, the soil has less than 35 percent gravel.

Included with this soil in mapping are small areas of Fordville and Renshaw soils. These soils make up about 5 to 25 percent of the unit. They occur as areas intermingled with areas of the Sioux soil. They have a subsoil of loam.

Permeability is very rapid in the Sioux soil. Runoff is slow. Available water capacity is low. Organic matter content is moderate. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for range or wildlife habitat. This soil generally is unsuited to cultivated crops because of droughtiness. It is best suited to range and pasture. The important native forage plants are blue grama, needleandthread, and sedges. Crested wheatgrass and western wheatgrass are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

This soil generally is unsuited to the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs can be grown for esthetic purposes or to enhance wildlife habitat if special management, such as hand or scalp planting, is applied.

The land capability classification is VIs. The productivity index for spring wheat is 0. The range site is Very Shallow.

62C—Sioux-Barnes loams, 3 to 9 percent slopes. These deep, undulating and gently rolling soils are on till plains intermingled with small eskers. The excessively drained Sioux soil is on knolls and ridges. The well drained Barnes soil is on side slopes. Individual areas of this unit range from about 5 to 30 acres in size. They are about 50 to 60 percent Sioux soil and 30 to 45 percent Barnes soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Sioux soil is black loam about 8 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown very gravelly coarse sand. In some places the soil has a thin subsoil. In other places the gravel consists mostly of shale.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In places the surface layer is gravelly loam.

Included with these soils in mapping are small areas of the moderately well drained Svea soils in swales. These included soils make up about 10 to 20 percent of the unit.

Permeability is very rapid in the Sioux soil and moderately slow in the Barnes soil. Runoff is slow on the Sioux soil and rapid on the Barnes soil. Available water capacity is low in the Sioux soil and high in the Barnes soil. Organic matter content is moderate in the Sioux soil and high in the Barnes soil.

Most areas are used for cultivated crops. These soils generally are unsuited to small grain, flax, corn, and sunflowers because of the droughtiness of the Sioux soil. They are best suited to range and pasture. The main concerns in managing cultivated areas are controlling water erosion and overcoming the droughtiness of the Sioux soil. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Grassed waterways in areas where runoff concentrates and a system of conservation tillage that

leaves crop residue on the surface help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, blue grama, and needleandthread. Crested wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth and helps to control water erosion.

The Sioux soil generally is unsuited to the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Barnes soil is suited to nearly all of the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Sioux soil is VIs, and that of the Barnes soil is IIIe. The productivity index of the unit for spring wheat is 0. The range site of the Sioux soil is Very Shallow, and that of the Barnes soil is Silty.

64—Sinai silty clay, 0 to 2 percent slopes. This deep, level and nearly level, moderately well drained soil is on flats on lake plains. Individual areas range from about 20 to more than 100 acres in size.

Typically, the surface layer is black silty clay about 9 inches thick. The subsoil is silty clay about 40 inches thick. It is black in the upper part and olive gray in the lower part. The substratum to a depth of about 60 inches is olive clay loam.

Included with this soil in mapping are small areas of Barnes, Overly, and Spottswood soils. These soils make up about 10 percent of the unit. The Barnes soils are on rises. They have a surface layer and subsoil of loam. The Overly soils occur as areas intermingled with areas of the Sinai soil. They have a subsoil of silt loam. The Spottswood soils are on flats. They have a gravelly substratum.

Permeability is slow in the Sinai soil. Runoff is very slow. Available water capacity and organic matter content are high. Tilth is poor.

Most areas are used for cultivated crops. This soil is well suited to small grain, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are maintaining or improving tilth and controlling soil blowing. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. Returning crop residue to the soil also improves tilth. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks, grassed waterways in areas where runoff concentrates, and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing and water erosion. Conservation tillage also helps to maintain or improve tilth and to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, green needlegrass, and porcupinegrass. Smooth brome, Russian wildrye, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIs. The productivity index for spring wheat is 89. The range site is Clayey.

65B—Serden-Hamar complex, 0 to 6 percent slopes. These deep soils are on outwash plains and lake plains. The nearly level and undulating, excessively drained Serden soil is on flats and rises. The level and nearly level, poorly drained Hamar soil is in swales and depressions. Individual areas of this unit range from about 10 to more than 50 acres in size. They are about 60 to 75 percent Serden soil and 25 to 40 percent Hamar soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Serden soil is very dark grayish brown fine sand about 4 inches thick. The next layer also is very dark grayish brown fine sand. It is about 5 inches thick. The substratum to a depth of about 60 inches is dark brown fine sand. In places the soil has a dark brown surface layer.

Typically, the Hamar soil has a loamy fine sand surface soil about 12 inches thick. The upper part is black, and the lower part is very dark brown and is mottled. The substratum to a depth of about 60 inches is mottled fine sand. It is light brownish gray in the

upper part and olive gray in the lower part. In places the upper part of the surface layer is mottled.

Included with these soils in mapping are small areas of Hecla, Maddock, Rosewood, and Ulen soils. These included soils make up about 5 to 15 percent of the unit. The Hecla and Maddock soils occur as areas intermingled with areas of the Serden soil. They have a surface layer that is darker and thicker than that of the Serden soil. The Rosewood soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches. The somewhat poorly drained Ulen soils are on flats. Also included are small areas of blowouts.

Permeability is rapid in the Serden and Hamar soils. Runoff is very slow on the Serden soil and slow on the Hamar soil. Available water capacity is low in both soils. Organic matter content is low in the Serden soil and moderate in the Hamar soil. A seasonal high water table is at a depth of 0.5 foot to 2.0 feet in the Hamar soil.

Most areas are used for range. Because of droughtiness and the hazard of erosion, these soils are generally unsuited to cultivated crops. They are best suited to hay and range. The important native forage plants are prairie sandreed, sand bluestem, big bluestem, and needleandthread. Soil blowing is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the important plants at a height that traps snow helps to store water in the soil and control soil blowing. Blowouts can occur along cattle trails and in areas where cattle congregate. A planned grazing system that controls the pattern of livestock traffic helps to prevent blowouts. Root shearing is a hazard on the Hamar soil, especially if the range is grazed when the soil is wet. Grazing should be deferred during wet periods.

The Serden soil is suited to a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and the trees and shrubs are commonly affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity. If drained, the Hamar soil is suited to all of the climatically adapted species. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on the Hamar soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Serden soil is VIe, and that of the Hamar soil is IVw. The productivity index of the unit for spring wheat is 0. The range site of the Serden soil is Thin Sands, and that of the Hamar soil is Subirrigated.

66—Spottswood loam, 1 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on flats on outwash plains. Individual areas range from about 2 to more than 100 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsoil is about 25 inches thick. In sequence downward, it is very dark gray clay loam; black clay loam; grayish brown, mottled loam; and light olive brown, mottled gravelly loam. The substratum to a depth of about 60 inches is light olive brown, mottled very gravelly coarse sand.

Included with this soil in mapping are small areas of Divide and Fordville soils. These soils make up about 5 to 20 percent of the unit. They occur as areas intermingled with areas of the Spottswood soil. The Divide soils are somewhat poorly drained. The Fordville soils are well drained.

Permeability is moderate in the upper part of the Spottswood soil and rapid in the lower part. Runoff is slow. Available water capacity is moderate. Organic matter content is high. A seasonal high water table is at a depth of 3 to 6 feet. Tilth is good. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. It is best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concerns in managing cultivated areas are maintaining fertility and tilth and overcoming droughtiness. The hazard of soil blowing or water erosion is slight. Incorporating organic material into the surface layer helps to maintain or improve tilth and fertility. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Big bluestem, smooth brome, and alfalfa are suitable hay and pasture plants. No major problems affect the use of this soil for range or pasture.

This soil is suited to nearly all of the climatically

adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIs. The productivity index for spring wheat is 69. The range site is Silty.

67—Stirum fine sandy loam. This deep, level, poorly drained and very poorly drained, highly calcareous, moderately saline, sodic soil is on flats and in drainageways on lake plains. Individual areas range from about 5 to more than 200 acres in size.

Typically, the surface layer is black fine sandy loam about 6 inches thick. It has filaments of salt. The subsoil is about 32 inches thick. In sequence downward, it is very dark gray fine sandy loam, dark gray fine sandy loam, dark gray loamy fine sand, and light gray and gray loamy fine sand. The substratum extends to a depth of about 60 inches. In sequence downward, it is olive gray, mottled loamy fine sand; olive gray, mottled silt loam; light olive gray, mottled silt loam; and dark grayish brown and olive gray, mottled loamy fine sand. In some places the soil has more clay and is somewhat poorly drained. In other places it is subject to ponding during wet periods.

Included with this soil in mapping are small areas of Colvin, Hecla, and Ulen soils. These soils make up about 5 percent of the unit. They do not have a dense, sodic subsoil. The poorly drained Colvin soils are in drainageways. The moderately well drained Hecla and somewhat poorly drained Ulen soils are on rises.

Permeability is moderately slow in the upper part of the Stirum soil and rapid in the lower part. Runoff is very slow. Available water capacity is moderate. Organic matter content is high. A seasonal high water table is at a depth of 1 to 3 feet. The dense, sodic subsoil restricts the depth to which roots can penetrate. Salts reduce the amount of water available to plants.

Most areas are used for range or pasture, but some are used for cultivated crops. This soil is best suited to pasture, range, and hay. Because of salinity, alkalinity, and wetness, it generally is unsuited to cultivated crops. The important native forage plants are western wheatgrass, switchgrass, and big bluestem. Tall wheatgrass and sweetclover are suitable hay and pasture plants. The dense, sodic subsoil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Trampling, compaction, and root shearing are problems. Grazing should be deferred during wet periods. Maintaining an adequate cover of the salt-tolerant plants helps to control soil blowing and to leach salts from the root zone. Stock water ponds constructed in areas of this soil frequently contain salty water.

This soil is suited to only a few of the most drought- and salt-tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Supplemental watering or irrigation helps to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor. They are affected by restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soil. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is VIs. The productivity index for spring wheat is 0. The range site is Subirrigated.

68—Stirum-Letcher fine sandy loams. These deep, level soils are on outwash plains and lake plains. The poorly drained and very poorly drained, moderately saline, sodic Stirum soil is in swales and depressions. The somewhat poorly drained, sodic Letcher soil is on flats and rises. Individual areas of this unit range from about 5 to more than 50 acres in size. They are about 60 to 80 percent Stirum soil and 15 to 35 percent Letcher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Stirum soil is black fine sandy loam about 6 inches thick. It has filaments of salt. The subsoil is about 32 inches thick. It is very dark gray fine sandy loam in the upper part, dark gray loamy fine sand in the next part, and light gray and gray loamy fine sand in the lower part. The substratum extends to a depth of about 60 inches. It is mottled. In sequence downward, it is olive gray loamy fine sand, olive gray silt loam, light olive gray silt loam, and dark grayish brown and olive gray loamy fine sand. In places the soil has more clay.

Typically, the surface layer of the Letcher soil is black fine sandy loam about 8 inches thick. The subsurface layer is very dark gray sandy loam about 1 inch thick. The subsoil is about 33 inches thick. In sequence downward, it is dark brown, mottled, dense sandy loam; dark grayish brown, mottled sandy loam; grayish brown loam; and olive gray loam. The substratum to a depth of about 60 inches is olive brown, mottled fine sandy loam. In places the subsoil is friable and nonsodic.

Included with these soils in mapping are small areas of Hecla and Rosewood soils. These included soils make up about 5 to 25 percent of the unit. They do not have a dense, sodic subsoil. The Hecla soils are on

rises. The Rosewood soils are in depressions.

Permeability is moderately slow in the upper part of the Stirum soil and rapid in the lower part. It is slow in the upper part of the Letcher soil and moderately rapid in the lower part. Runoff is very slow on the Stirum soil and slow on the Letcher soil. Available water capacity is moderate in both soils. Organic matter content is high in the Stirum soil and moderate in the Letcher soil. A seasonal high water table is at a depth of 1.0 to 3.0 feet in the Stirum soil and at a depth of 3.5 to 6.0 feet in the Letcher soil. The dense, sodic subsoil restricts the depth to which roots can penetrate. Salts reduce the amount of water available to plants.

Most areas are used for cultivated crops. These soils are best suited to range, pasture, and hay. Because of the dense, sodic subsoil, they generally are unsuited to cultivated crops. In areas where the soils are used for range, the important native forage plants are western wheatgrass, big bluestem, slender wheatgrass, switchgrass, and needleandthread. Tall wheatgrass and sweetclover are suitable hay and pasture plants. The dense, sodic subsoil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the range or pasture is overgrazed. Trampling, compaction, and root shearing are problems. Grazing should be deferred during wet periods. Maintaining an adequate cover of the salt-tolerant plants helps to control soil blowing and to leach salts from the root zone. Stock water ponds constructed in areas of these soils frequently contain salty water.

These soils are suited to only a few of the drought- and salt-tolerant, climatically adapted species. Supplemental watering or irrigation helps to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the restricted root development in the subsoil and by the limited available water capacity caused by the salts in the soils. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Stirum soil is VIs, and that of the Letcher soil is IVs. The productivity index of the unit for spring wheat is 0. The range site of the Stirum soil is Subirrigated, and that of the Letcher soil is Sandy Claypan.

69—Letcher fine sandy loam. This deep, level, somewhat poorly drained, sodic soil is on flats and in swales on outwash plains. Individual areas range from about 5 to more than 50 acres in size.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsurface layer is very dark gray sandy loam about 1 inch thick. The subsoil is about 33 inches thick. In sequence downward, it is dark brown, mottled, dense sandy loam; dark grayish brown, mottled sandy loam; grayish brown loam; and olive gray loam. The substratum to a depth of about 60 inches is olive brown, mottled fine sandy loam. In places the upper part of the subsoil is mottled.

Included with this soil in mapping are small areas of well drained Embden soils. They are on rises. Also included are some moderately well drained, sodic soils. They occur as areas intermingled with areas of the Letcher soil. Included soils make up about 10 percent of the unit.

Permeability is slow in the upper part of the Letcher soil and moderately rapid in the lower part. Runoff is slow. Available water capacity and organic matter content are moderate. A seasonal high water table is at a depth of 3.5 to 6.0 feet. Tilth is poor. The dense, sodic subsoil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. Because of the dense, sodic subsoil, this soil is poorly suited to most types of small grain and to flax and sunflowers. It is best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing and improving root penetration in the subsoil. Because of moisture stress in most years, crop growth is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the soluble salts adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the subsoil. The hazard of soil blowing is severe, but the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Little benefit is derived from fallowing because of the moderate available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, needleandthread, and blue grama. Intermediate wheatgrass, tall wheatgrass, and alfalfa are suitable hay and pasture plants. The dense subsoil that restricts root penetration and the salts that reduce the amount of water available to plants are problems, especially if the

range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing and to leach salts from the root zone.

This soil is suited to only a few of the most salt-tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs vary in height, density, and vigor. They are affected by the reduced amount of available water caused by the salts in the soil. Reducing the evaporation rate at the surface improves seedling survival. When a bare soil surface dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IVs. The productivity index for spring wheat is 26. The range site is Sandy Claypan.

70—Svea loam. This deep, level, moderately well drained soil is on flats on till plains. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsoil is 29 inches thick. In sequence downward, it is very dark gray loam; very dark grayish brown loam; dark grayish brown loam; and light olive brown, mottled clay loam. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam. In places the subsoil has more clay, more sand, or both.

Included with this soil in mapping are small areas of Cresbard, Hamerly, and Tonka soils. These soils make up about 5 to 15 percent of the unit. The Cresbard soils occur as areas intermingled with areas of the Svea soil. They have a dense, sodic subsoil. The somewhat poorly drained Hamerly soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches. The poorly drained Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately slow in the Svea soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 4 to 6 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is maintaining fertility and tilth. Incorporating organic material into the surface layer improves tilth and fertility. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are western wheatgrass, green needlegrass, and big bluestem. Intermediate wheatgrass, smooth brome, Russian wildrye, and alfalfa are suitable hay and pasture plants. No major problems affect the use of this soil for range or pasture.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification is IIc. The productivity index for spring wheat is 91. The range site is Overflow.

71—Svea-Cresbard loams, 0 to 2 percent slopes. These deep, level and nearly level, moderately well drained soils are on till plains. The Svea soil is on microswells. The sodic Cresbard soil is in microswales. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 50 to 60 percent Svea soil and 30 to 40 percent Cresbard soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Svea soil is black loam about 8 inches thick. The subsoil is about 29 inches thick. In sequence downward, it is very dark gray loam; very dark grayish brown loam; dark grayish brown loam; and light olive brown, mottled clay loam. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam.

Typically, the surface layer of the Cresbard soil is loam about 9 inches thick. The upper part is black, and the lower part is very dark gray. The next layer is about 3 inches thick. It is black loam that has grayish brown silt coatings. The subsoil is dense clay loam about 22 inches thick. It is very dark grayish brown in the upper part, dark grayish brown in the next part, and light olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled clay loam. In places the subsoil is very dense.

Included with these soils in mapping are small areas of Barnes, Hamerly, and Tonka soils. These included soils make up about 5 to 10 percent of the unit. The well drained Barnes soils are on rises. They have a surface layer that is dark to a depth of only 7 to 15 inches. The somewhat poorly drained Hamerly soils are on the rims of depressions. They have an accumulation of lime within a depth of 16 inches. The poorly drained

Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately slow in the Svea soil and slow in the Cresbard soil. Runoff is slow on both soils. Available water capacity and organic matter content are high in the Svea soil and moderate in the Cresbard soil. A seasonal high water table is at a depth of 4 to 6 feet in both soils. Tilth is good in the Svea soil and fair in the Cresbard soil. The dense, sodic subsoil of the Cresbard soil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are improving root penetration in the subsoil of the Cresbard soil and maintaining tilth and fertility. Because of moisture stress in most years, crop growth on the Cresbard soil is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts in the Cresbard soil adversely affect crop production by restricting root penetration and by inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the subsoil. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to maintain tilth and fertility and to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, needleandthread, big bluestem, and green needlegrass. Pubescent wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. No major problems affect the use of these soils for range or pasture.

The Svea soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Cresbard soil is suited to many of the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Individual trees and shrubs on the Cresbard soil vary in height, density, and vigor. They are affected by the restricted root development in the subsoil and by the reduced amount of available water caused by the salts in the soils.

The land capability classification of the Svea soil is IIc, and that of the Cresbard soil is IIIs. The productivity index of the unit for spring wheat is 86. The range site of the Svea soil is Overflow, and that of the Cresbard soil is Clayey.

72—Swenoda fine sandy loam, 1 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on flats on till plains and lake plains. Individual areas range from about 10 to more than 300 acres in size.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 22 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is loam. It is grayish brown in the upper part and light brownish gray and mottled in the lower part. In places the substratum is fine sandy loam or fine sand between depths of 40 and 60 inches. In an area north of Oakes, along the La Moure County border, the slope is as much as 5 percent.

Included with this soil in mapping are small areas of Barnes and Letcher soils. These soils make up about 10 percent of the unit. The Barnes soils are on rises. They have a subsoil of loam. The Letcher soils occur as areas intermingled with areas of the Swenoda soil. They have a dense, sodic subsoil.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderately slow in the lower part. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 2.5 to 4.0 feet. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to small grain, flax, and sunflowers and to grass-legume hay. It is best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concern in managing cultivated areas is controlling soil blowing. The hazard of soil blowing is severe, but the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where this soil is used for range, the important native forage plants are green needlegrass, needleandthread, and prairie sandreed. Pubescent wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and control soil blowing.

This soil is suited to all of the climatically adapted

trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIe. The productivity index for spring wheat is 72. The range site is Sandy.

73—Swenoda-Letcher fine sandy loams, 1 to 3 percent slopes. These deep, nearly level soils are on till plains. The moderately well drained Swenoda soil is on rises. The somewhat poorly drained, sodic Letcher soil is on flats and in swales. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 55 to 70 percent Swenoda soil and 20 to 30 percent Letcher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Swenoda soil is black fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 22 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is loam. It is grayish brown in the upper part and light brownish gray and mottled in the lower part.

Typically, the surface layer of the Letcher soil is black fine sandy loam about 8 inches thick. The subsurface layer is very dark gray sandy loam about 1 inch thick. The subsoil is about 33 inches thick. In sequence downward, it is dark brown, mottled, dense sandy loam; dark grayish brown, mottled sandy loam; grayish brown loam; and olive gray loam. The substratum to a depth of about 60 inches is olive brown, mottled fine sandy loam. In places salts are within a depth of 16 inches.

Included with these soils in mapping are small areas of Barnes, Clontarf, and Embden soils. These included soils make up about 10 to 25 percent of the unit. The Barnes soils are on rises. They have a subsoil of loam. The Clontarf and Embden soils occur as areas intermingled with areas of the Swenoda soil. The Clontarf soils have a substratum of fine sand. The Embden soils have more sand in the substratum than the Swenoda and Letcher soils.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderately slow in the lower part. It is slow in the upper part of the Letcher soil and moderately rapid in the lower part. Runoff is slow on both soils. Available water capacity and organic matter content are high in the Swenoda soil and moderate in the Letcher soil. A seasonal high water table is at a depth of 2.5 to 4.0 feet in the Swenoda soil and 3.5 to 6.0 feet in the Letcher soil. Tilth is good in the Swenoda soil and fair in the Letcher soil. The dense, sodic subsoil of the Letcher soil restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, and sunflowers and to grass-legume hay. They are best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing and improving root penetration in the subsoil of the Letcher soil. Because of moisture stress in most years, crop growth on the Letcher soil is uneven, especially as the crop nears maturity. The dense, sodic subsoil and the salts in the Letcher soil adversely affect crop production by restricting root penetration and inhibiting moisture use. The surface tends to puddle when wet and to form clods when dry. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A cropping system that includes deep-rooted legumes, such as alfalfa, and deep tillage improve root penetration in the subsoil. The hazard of soil blowing is severe, but the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are slender wheatgrass, prairie sandreed, green needlegrass, and western wheatgrass. Intermediate wheatgrass, alfalfa, and sweetclover are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

The Swenoda soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Letcher soil is suited to only a few of the drought- and salt-tolerant, climatically adapted species. Individual trees and shrubs vary in height, density, and vigor. They are affected by the restricted root development in the dense, sodic subsoil and by the reduced amount of available water caused by the salts in the soils. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to

control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Swenoda soil is IIIe, and that of the Letcher soil is IVs. The productivity index of the unit for spring wheat is 65. The range site of the Swenoda soil is Sandy, and that of the Letcher soil is Sandy Claypan.

74—Swenoda-Barnes complex, 1 to 3 percent slopes. These deep, nearly level soils are on eolian-mantled till plains. The moderately well drained Swenoda soil is on flats and in swales. The well drained Barnes soil is on rises. Individual areas of this unit range from about 20 to more than 200 acres in size. They are about 60 to 75 percent Swenoda soil and 15 to 25 percent Barnes soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Swenoda soil is black fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 22 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is loam. It is grayish brown in the upper part and light brownish gray and mottled in the lower part. In places the substratum is fine sandy loam or fine sand between depths of 40 and 60 inches.

Typically, the surface layer of the Barnes soil is black loam about 8 inches thick. The subsoil is loam about 18 inches thick. It is dark brown in the upper part and olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Included with these soils in mapping are small areas of Letcher and Tonka soils. These included soils make up about 5 to 25 percent of the unit. The Letcher soils occur as areas intermingled with areas of the Swenoda soil. They have a dense, sodic subsoil. The poorly drained Tonka soils are in depressions. They have a subsurface layer.

Permeability is moderately rapid in the upper part of the Swenoda soil and moderately slow in the lower part. It is moderately slow in the Barnes soil. Runoff is slow on both soils. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 2.5 to 4.0 feet in the Swenoda soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are suited to small grain, flax, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling soil blowing. The hazard of soil blowing is severe on the Swenoda soil and slight on the Barnes soil. The hazard of water erosion is slight on both soils. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, prairie sandreed, and green needlegrass. Pubescent wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

The Swenoda soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Barnes soil is suited to nearly all of the climatically adapted species. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Swenoda soil is IIIe, and that of the Barnes soil is IIc. The productivity index of the unit for spring wheat is 78. The range site of the Swenoda soil is Sandy, and that of the Barnes soil is Silty.

77—Towner loamy fine sand, 0 to 3 percent slopes. This deep, level and nearly level, moderately well drained soil is on flats on till plains and lake plains. Individual areas range from about 10 to more than 1,000 acres in size.

Typically, the surface soil is black loamy fine sand about 17 inches thick. The upper part of the substratum is olive brown fine sand. The lower part to a depth of about 60 inches is grayish brown silt loam. In some places the dark surface layer extends to a depth of only 8 to 16 inches. In other places the substratum is loamy fine sand or sand between depths of 40 and 60 inches. In a few areas the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Embden and Ulen soils. These soils make up about 10 percent of the unit. The Embden soils occur as areas intermingled with areas of the Towner soil. They have more silt and clay in the upper part than the Towner soil. The somewhat poorly drained Ulen soils are in swales. They have an accumulation of lime within a depth of 16 inches.

Permeability is rapid in the upper part of the Towner soil and moderately slow in the lower part. Runoff is slow. Available water capacity is moderate. Organic matter content is moderately low. A seasonal high water table is at a depth of 3 to 6 feet. Tilth is fair.

Most areas are used for cultivated crops or hay, but some are used for pasture or range. Because of droughtiness, this soil is poorly suited to most types of small grain and to flax and sunflowers. It is best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they can make the best use of the early season moisture supply. The main concerns in managing cultivated areas are overcoming droughtiness and controlling soil blowing. The hazard of soil blowing is severe, but the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the moderate available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where this soil is used for range, the important native forage plants are needleandthread, sand bluestem, and prairie sandreed. Intermediate wheatgrass, pubescent wheatgrass, and alfalfa are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and control soil blowing. Blowouts can occur along cattle trails and in areas where cattle congregate. They can be prevented by a planned grazing system that controls the pattern of livestock traffic.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It is somewhat droughty, however, and the trees and shrubs commonly are affected by moisture stress, particularly during the establishment period. Irrigation or supplemental watering helps to ensure the survival of seedlings. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IVe. The productivity index for spring wheat is 54. The range site is Sands.

78—Ulen fine sandy loam. This deep, level, somewhat poorly drained, highly calcareous soil is on flats on outwash plains and lake plains. Individual areas range from about 5 to more than 250 acres in size.

Typically, the surface soil is black fine sandy loam about 12 inches thick. The upper part of the subsoil is dark grayish brown and light brownish gray fine sandy loam about 4 inches thick. The next part is very dark grayish brown, mottled fine sandy loam about 4 inches thick. The lower part is light olive gray, mottled loamy fine sand about 16 inches thick. The substratum to a depth of about 60 inches is fine sand. It is olive gray in the upper part and dark grayish brown in the lower part. In some places the substratum is silt loam or silty clay loam below a depth of 40 inches. In other places the soil has more clay throughout.

Included with this soil in mapping are small areas of Glyndon, Hamar, and Hecla soils. These soils make up about 15 percent of the unit. The Glyndon soils occur as areas intermingled with areas of the Ulen soil. They have more silt and clay than the Ulen soil. The poorly drained Hamar soils are in depressions. The moderately well drained Hecla soils are on rises.

Permeability is rapid in the Ulen soil. Runoff is slow. Available water capacity is low. Organic matter content is moderate. A seasonal high water table is at a depth of 2.5 to 6.0 feet. Tilth is good.

Most areas are used for cultivated crops, but some are used for hay or pasture. This soil is suited to small grain and flax and to grass-legume hay. It is best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing, conserving moisture, and maintaining fertility. The hazard of soil blowing is severe, but the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to maintain fertility and to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where this soil is used for range, the important native forage plants are switchgrass, little bluestem, and big bluestem. Tall wheatgrass, sweetclover, and birdsfoot trefoil are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

This soil is suited to all of the climatically adapted

trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIe. The productivity index for spring wheat is 54. The range site is Limy Subirrigated.

79—Ulen-Hamar complex. These deep, level soils are on outwash plains and lake plains. The highly calcareous, somewhat poorly drained Ulen soil is on flats. The poorly drained Hamar soil is in swales and shallow depressions. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 40 to 65 percent Ulen soil and 35 to 50 percent Hamar soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Ulen soil has a black fine sandy loam surface soil about 12 inches thick. The upper part of the subsoil is dark grayish brown and light brownish gray fine sandy loam about 4 inches thick. The next part is very dark grayish brown, mottled fine sandy loam about 4 inches thick. The lower part is light olive gray, mottled loamy fine sand about 16 inches thick. The substratum to a depth of about 60 inches is fine sand. It is olive gray in the upper part and dark grayish brown in the lower part. In places the substratum is silt loam or silty clay loam below a depth of 40 inches.

Typically, the Hamar soil has a loamy fine sand surface soil about 12 inches thick. The upper part is black, and the lower part is very dark brown and is mottled. The substratum to a depth of about 60 inches is mottled fine sand. It is light brownish gray in the upper part and olive gray in the lower part.

Included with these soils in mapping are small areas of Rosewood, Stirum, and Tiffany soils. These included soils make up about 5 to 25 percent of the unit. The poorly drained Rosewood and Stirum soils occur as areas intermingled with areas of the Ulen soil. The Stirum soils have a dense, sodic subsoil. The Tiffany soils occur as areas intermingled with areas of the Hamar soil. They have more clay in the subsoil than the Hamar soil.

Permeability is rapid in the Ulen and Hamar soils. Runoff is slow. Available water capacity is low. Organic matter content is moderate. A seasonal high water table is at a depth of 2.5 to 6.0 feet in the Ulen soil and at a depth of 0.5 foot to 2.0 feet in the Hamar soil. Tilth is fair in both soils.

Most areas are used for pasture or hay, but some are cultivated. These soils are poorly suited to most types of small grain and to flax and sunflowers but are suited to grass-legume hay. They are best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are controlling soil blowing and maintaining fertility. The hazard of soil blowing is severe, and the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, stripcropping, field windbreaks, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to maintain fertility and to provide food and cover for resident and migratory wildlife. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing. The wetness of the Hamar soil sometimes delays tillage, seeding, or harvest operations.

In areas where these soils are used for range, the important native forage plants are big bluestem, indiangrass, little bluestem, and switchgrass. Intermediate wheatgrass, tall wheatgrass, and sweetclover are suitable hay and pasture plants. Soil blowing is a problem, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and control soil blowing. Blowouts can occur along cattle trails and in areas where cattle congregate. They can be prevented by a planned grazing system that controls the pattern of livestock traffic. Compaction, trampling, and root shearing are problems in areas of the Hamar soil, especially if the range is grazed when the soil is wet. Grazing should be deferred during wet periods. The wetness hinders haying in some years.

The Ulen soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. If drained, the Hamar soil is suited to all of the climatically adapted species. Undrained areas generally are unsuited. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds on the Hamar soil are abundant and persistent. Eliminating the grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Ulen soil is IIIe, and that of the Hamar soil is IVw. The productivity

index of the unit for spring wheat is 54. The range site of the Ulen soil is Limy Subirrigated, and that of the Hamar soil is Subirrigated.

80—Makoti-Sakakawea silt loams, 1 to 3 percent slopes. These deep, nearly level soils are on lake plains. The moderately well drained Makoti soil is on flats and in swales. The well drained Sakakawea soil is on rises and flats. Individual areas of this unit range from about 10 to more than 50 acres in size. They are about 60 to 75 percent Makoti soil and 25 to 35 percent Sakakawea soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Makoti soil is black silt loam about 9 inches thick. The subsoil is silty clay loam about 25 inches thick. It is very dark brown in the upper part, very dark gray in the next part, and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown, mottled silt loam. In some places the soil has more clay. In other places the substratum is loam or clay loam and contains about 2 to 8 percent gravel.

Typically, the surface layer of the Sakakawea soil is very dark gray silt loam about 7 inches thick. The subsoil is grayish brown silt loam about 19 inches thick. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam. In some places the subsoil has more clay. In other places the surface layer is more than 10 inches thick.

Included with these soils in mapping are small areas of Zahl soils on knolls and ridges. These included soils make up about 5 to 15 percent of the unit. They have more sand throughout than the Makoti and Sakakawea soils.

Permeability is moderately slow in the Makoti soil and moderate in the Sakakawea soil. Runoff is slow on both soils. Available water capacity is high. Organic matter content is high in the Makoti soil and moderate in the Sakakawea soil. A seasonal high water table is at a depth of 5 to 6 feet in the Makoti soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling soil blowing. The hazard of soil blowing is slight on the Makoti soil and moderate on the Sakakawea soil. The hazard of water erosion is slight on both soils. Field windbreaks, stripcropping, and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, little bluestem, western wheatgrass, and green needlegrass. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

The Makoti soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. The Sakakawea soil is suited only to the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on the Sakakawea soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Makoti soil is IIc, and that of the Sakakawea soil is IIIe. The productivity index of the unit for spring wheat is 80. The range site of the Makoti soil is Silty, and that of the Sakakawea soil is Thin Upland.

81B—Makoti-Sakakawea silt loams, 3 to 6 percent slopes. These deep, undulating soils are on lake plains. The moderately well drained Makoti soil is in swales. The well drained Sakakawea soil is on rises. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 50 to 70 percent Makoti soil and 25 to 45 percent Sakakawea soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Makoti soil is black silt loam about 9 inches thick. The subsoil is silty clay loam about 25 inches thick. It is very dark brown in the upper part, very dark gray in the next part, and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown, mottled silt loam. In some places the soil has more clay. In other places the substratum is loam or clay loam and contains about 2 to 8 percent gravel.

Typically, the surface layer of the Sakakawea soil is very dark gray silt loam about 7 inches thick. The subsoil is grayish brown silt loam about 19 inches thick. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam. In places the subsoil has more clay.

Included with these soils in mapping are small areas of Zahl soils on knolls and ridges. These included soils make up about 5 to 25 percent of the unit. They have

more sand throughout than the Makoti and Sakakawea soils.

Permeability is moderately slow in the Makoti soil and moderate in the Sakakawea soil. Runoff is slow on the Makoti soil and medium on the Sakakawea soil. Available water capacity is high in both soils. Organic matter content is high in the Makoti soil and moderate in the Sakakawea soil. A seasonal high water table is at a depth of 5 to 6 feet in the Makoti soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling soil blowing and water erosion. The hazard of soil blowing is slight on the Makoti soil and moderate on the Sakakawea soil. The hazard of water erosion is moderate on both soils. Grassed waterways in areas where runoff concentrates, field windbreaks, stripcropping, and a system of conservation tillage that leaves crop residue on the surface help to control water erosion and soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, little bluestem, and green needlegrass. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing and water erosion are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing and water erosion.

The Makoti soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It has no critical limitations. The Sakakawea soil is suited only to the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on the Sakakawea soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Makoti soil is IIe, and that of the Sakakawea soil is IIIe. The productivity index of the unit for spring wheat is 70. The range site of the Makoti soil is Silty, and that of the Sakakawea soil is Thin Upland.

85B—Lehr-Wabek loams, 1 to 6 percent slopes. These deep, nearly level and undulating soils are on outwash plains. The somewhat excessively drained Lehr soil is on flats. The excessively drained Wabek soil is on knolls and ridges. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 40 to 65 percent Lehr soil and 35 to 50 percent Wabek soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Lehr soil is very dark brown loam about 9 inches thick. The subsoil is loam about 8 inches thick. It is dark brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is dark grayish brown gravelly coarse sand. In some places the gravelly substratum is at a depth of more than 20 inches. In other places the substratum is mostly shale fragments.

Typically, the surface layer of the Wabek soil is very dark brown loam about 6 inches thick. The upper part of the substratum is dark grayish brown gravelly coarse sand. The lower part to a depth of about 60 inches is dark yellowish brown very gravelly coarse sand. In places the soil has a thin subsoil.

Included with these soils in mapping are small areas of Bowbells soils in swales. These included soils make up about 5 to 25 percent of the unit. They have a substratum of loam.

Permeability is moderately rapid in the upper part of the Lehr soil and very rapid in the lower part. It is very rapid in the Wabek soil. Runoff is slow on both soils. Available water capacity is low in the Lehr soil and very low in the Wabek soil. Organic matter content is moderate in the Lehr soil and moderately low in the Wabek soil. The sand and gravel in both soils restrict the depth to which roots can penetrate. Tilth is good in both soils.

Most areas are used for pasture or hay. These soils are poorly suited to most types of small grain and to flax, corn, and sunflowers. They are best suited to rye and winter wheat, which make the best use of the early season moisture supply. The main concern in managing cultivated areas is overcoming droughtiness. The hazard of soil blowing or water erosion is slight. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply.

In areas where these soils are used for range, the important native forage plants are needleandthread, western wheatgrass, and blue grama. Crested wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a

height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

The Lehr soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Wabek soil generally is unsuited to these uses. The soils are droughty, and the trees and shrubs are commonly affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low and very low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of the Lehr soil is IIIe, and that of the Wabek soil is VIs. The productivity index of the unit for spring wheat is 31. The range site of the Lehr soil is Shallow to Gravel, and that of the Wabek soil is Very Shallow.

86E—Wabek loam, 6 to 25 percent slopes. This deep, moderately sloping to moderately steep, excessively drained soil is on knobs and ridges on outwash plains. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is very dark brown loam about 6 inches thick. The upper part of the substratum is dark grayish brown gravelly coarse sand. The lower part to a depth of about 60 inches is dark yellowish brown very gravelly coarse sand. In places the soil has a thin subsoil.

Included with this soil in mapping are small areas of Lehr and Ruso soils. These soils make up about 5 to 25 percent of the unit. They occur as areas intermingled with areas of the Wabek soil. They are deeper over the gravelly substratum than the Wabek soil.

Permeability is very rapid in the Wabek soil. Runoff is medium. Available water capacity is low. Organic matter content is moderately low. The sand and gravel restrict the depth to which roots can penetrate.

Most areas are used for range or wildlife habitat. Because of droughtiness, this soil generally is unsuited to cultivated crops. It is best suited to range and pasture. The important native forage plants are blue grama, needleandthread, and western wheatgrass. Crested wheatgrass and western wheatgrass are suitable hay and pasture plants. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil and thus improves plant vigor and growth.

This soil generally is unsuited to the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs can be grown for esthetic purposes or to enhance wildlife habitat if special management, such as hand or scalp planting, is applied.

The land capability classification is VIIs. The productivity index for spring wheat is 0. The range site is Very Shallow.

90—Vallers loam. This deep, level, poorly drained, highly calcareous soil is on flats on till plains and moraines. Individual areas range from about 3 to more than 20 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The next layer is very dark grayish brown clay loam about 9 inches thick. The subsoil is light brownish gray, mottled silty clay loam about 5 inches thick. The substratum to a depth of about 60 inches is mottled loam. It is olive gray in the upper part and light olive gray in the lower part. In places the substratum is light yellowish brown.

Included with this soil in mapping are small areas of Parnell and Tonka soils in depressions. These soils make up about 10 to 25 percent of the unit. The very poorly drained Parnell and poorly drained Tonka soils have an accumulation of clay in the subsoil.

Permeability is moderately slow in the Vallers soil. Runoff is slow. Available water capacity and organic matter content are high. A seasonal high water table is at a depth of 1.0 to 2.5 feet. Tilth is fair.

Most areas are used for range, hay, or wetland wildlife habitat. This soil is best suited to these uses. If drained, it is suited to small grain, flax, and sunflowers. The main concerns in managing cultivated areas are overcoming wetness and controlling soil blowing. Locating suitable drainage outlets is difficult. As a result, few areas are drained. In undrained areas, tillage, seeding, or harvest operations are usually prevented or delayed by wetness and crops are harvested in only about 6 to 8 years out of 10. Drainage increases the suitability for crops. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Field windbreaks and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

The important native forage plants are big bluestem and switchgrass. In drained areas reed canarygrass, big bluestem, alsike clover, and creeping foxtail are suitable hay and pasture plants. Soil blowing is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control soil blowing.

If drained, this soil is suited to all of the climatically

adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas generally are unsuited to these uses. The wetness is a critical limitation affecting the survival, growth, and vigor of the trees and shrubs. The grasses and weeds growing on this soil are abundant and persistent. Eliminating this ground cover before the trees and shrubs are planted and then controlling the regrowth of this cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIw. The productivity index for spring wheat ranges from 40 to 71, depending on the degree of drainage. The range site is Subirrigated.

91B—Ruso sandy loam, 1 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on flats and rises on outwash plains and terraces. Individual areas range from about 10 to more than 50 acres in size.

Typically, the surface layer is very dark brown sandy loam about 8 inches thick. The subsoil is sandy loam about 18 inches thick. It is very dark grayish brown in the upper part and dark brown in the lower part. The substratum to a depth of about 60 inches is olive brown sand. In some places the depth to sand is less than 25 inches. In other places the dark surface layer extends to a depth of only 8 to 16 inches.

Included with this soil in mapping are small areas of Lehr and Wabek soils. These soils make up about 15 percent of the unit. The Lehr soils occur as areas intermingled with areas of the Ruso soil. They have a surface layer and subsoil of loam. The Wabek soils are on ridges and knolls. They have sand and gravel within a depth of 6 inches.

Permeability is moderately rapid in the upper part of the Ruso soil and very rapid in the lower part. Runoff is slow. Available water capacity is low. Organic matter content is moderate. Tilth is good. The sandy substratum restricts the depth to which roots can penetrate.

Most areas are used for cultivated crops. Because of droughtiness, this soil is poorly suited to most types of small grain and to flax and sunflowers. It is best suited to rye and winter wheat because these crops protect the surface against soil blowing in fall, winter, and spring and because they make the best use of the early season moisture supply. The main concerns in managing cultivated areas are overcoming droughtiness and controlling soil blowing. The hazard of soil blowing is severe, but the hazard of water erosion is slight. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and annual buffer strips, such as flax strips, help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Leaving tall stubble on the surface helps to overcome droughtiness by trapping snow and thus increasing the moisture supply. Little benefit is derived from fallowing because of the low available water capacity. Also, fallowing increases the susceptibility to soil blowing.

In areas where this soil is used for range, the important native forage plants are little bluestem, needleandthread, prairie sandreed, and western wheatgrass. Crested wheatgrass, sweetclover, and alfalfa are suitable hay and pasture plants. Soil blowing and droughtiness are problems, especially if the range or pasture is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the important plants or of other suitable plants at a height that traps snow helps to store water in the soil, control soil blowing, and prevent denuding. Because of soil blowing, denuding can occur along cattle trails. It can be prevented by a planned grazing system that controls the pattern of livestock traffic.

This soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings. It is droughty, however, and the trees and shrubs commonly are affected by moisture stress. Irrigation or supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing the season prior to planting because of the low available water capacity. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification is IIIe. The productivity index for spring wheat is 38. The range site is Sandy.

92B—Williams-Bowbells loams, 3 to 6 percent slopes. These deep, undulating soils are on till plains and moraines. The well drained Williams soil is on rises. The moderately well drained Bowbells soil is in swales. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 50 to 70 percent Williams soil and 25 to 40 percent Bowbells soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is very dark brown loam about 7 inches thick. The subsoil is about 27 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The

substratum to a depth of about 60 inches is light olive brown, mottled loam. In places the surface layer is black.

Typically, the surface layer of the Bowbells soil is black loam about 6 inches thick. The subsoil is about 27 inches thick. It is very dark brown clay loam in the upper part, very dark grayish brown clay loam in the next part, and light yellowish brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Included with these soils in mapping are small areas of Tonka and Zahl soils. These included soils make up about 5 to 25 percent of the unit. The poorly drained Tonka soils are in depressions. They have a subsurface layer. The well drained Zahl soils are on knolls and knobs. They have a subsoil that is calcareous throughout.

Permeability is moderately slow in the Williams and Bowbells soils. Runoff is medium. Available water capacity and organic matter content are high. Tilth is good.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concern in managing cultivated areas is controlling water erosion. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Grassed waterways in areas where runoff concentrates and a system of conservation tillage that leaves crop residue on the surface help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Water erosion is a hazard, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion.

The Williams soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Bowbells soil is suited to all climatically adapted species. It has no critical limitations. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings.

The land capability classification of both soils is IIe. The productivity index of the unit for spring wheat is 79. The range site is Silty.

93C—Williams-Zahl loams, 6 to 9 percent slopes. These deep, gently rolling, well drained soils are on moraines. The Williams soil is on summits and side slopes. The Zahl soil is on ridges and shoulder slopes. Individual areas of this unit range from about 10 to more than 100 acres in size. They are about 50 to 70 percent Williams soil and 25 to 45 percent Zahl soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is very dark brown loam about 7 inches thick. The subsoil is about 27 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In some areas the slope is less than 6 percent, but these areas are less than 5 acres in size. In other areas the surface layer is black.

Typically, the surface layer of the Zahl soil is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam. In places the surface layer is grayish brown and is only 1 to 4 inches thick.

Included with these soils in mapping are small areas of the moderately well drained Bowbells soils in swales. These included soils make up about 10 to 25 percent of the unit. They have a dark surface layer extending to a depth of 16 inches or more.

Permeability is moderately slow in the Williams and Zahl soils. Runoff is rapid. Available water capacity is high. Organic matter content is high in the Williams soil and moderate in the Zahl soil. Tilth is good in both soils.

Most areas are used for pasture, range, or cultivated crops. These soils are suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling water erosion and soil blowing. The hazard of soil blowing is slight on the Williams soil and moderate on the Zahl soil. The hazard of water erosion is severe on both soils. Grassed waterways in areas where runoff concentrates, a system of conservation tillage that leaves crop residue on the surface, and field windbreaks help to control water erosion and soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

The important native forage plants are western wheatgrass, green needlegrass, little bluestem, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Soil blowing and water erosion are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other

suitable plants helps to control soil blowing and water erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

The Williams soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Zahl soil is suited to only the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on the Zahl soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Williams soil is IIIe, and that of the Zahl soil is IVe. The productivity index of the unit for spring wheat is 61. The range site of the Williams soil is Silty, and that of the Zahl soil is Thin Upland.

94C—Williams loam, 3 to 9 percent slopes, very stony. This deep, undulating and gently rolling, well drained soil is on side slopes and summits on moraines. Individual areas range from about 10 to more than 100 acres in size. Stones cover about 10 to 25 percent of the surface.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsoil is about 27 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In places the surface layer is black.

Included with this soil in mapping are small areas of Bowbells, Max, and Zahl soils. These soils make up about 10 to 20 percent of the unit. The moderately well drained Bowbells soils are in swales. They have a surface layer that is dark to a depth of 16 inches or more. The Max soils occur as areas intermingled with areas of the Williams soil. They have a smaller accumulation of clay in the subsoil than the Williams soil. The Zahl soils are on ridges and knolls. They have a subsoil that is calcareous throughout.

Permeability is moderately slow in the Williams soil. Runoff is rapid. Available water capacity and organic matter content are high.

Most areas are used for range. Because of the stoniness, this soil generally is unsuited to cultivated crops. It is best suited to range. The important native forage plants are western wheatgrass, green needlegrass, and needleandthread. Water erosion is a hazard, especially if the range is overgrazed. Maintaining an adequate cover of the important plants helps to control water erosion. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

This soil generally is unsuited to the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs can be grown for esthetic purposes or to enhance wildlife habitat if special management, such as hand or scalp planting, is applied.

The land capability classification is VIs. The productivity index for spring wheat is 0. The range site is Silty.

95B—Bowbells-Zahl loams, 3 to 6 percent slopes. These deep, undulating soils are on till plains and moraines. The moderately well drained Bowbells soil is in swales. The well drained Zahl soil is on rises. Individual areas of this unit range from about 10 to more than 200 acres in size. They are about 50 to 60 percent Bowbells soil and 25 to 40 percent Zahl soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Bowbells soil is black loam about 6 inches thick. The subsoil is about 27 inches thick. It is very dark brown clay loam in the upper part, very dark grayish brown clay loam in the next part, and light yellowish brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In places the subsoil contains less clay.

Typically, the surface layer of the Zahl soil is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam. In places the surface layer is grayish brown and is only 1 to 4 inches thick.

Included with these soils in mapping are small areas of Tonka and Williams soils. These included soils make up about 10 to 25 percent of the unit. The poorly drained Tonka soils are in depressions. They have a subsurface layer. The well drained Williams soils are on side slopes. They have a surface layer that is dark to a depth of only 7 to 15 inches.

Permeability is moderately slow in the Bowbells and Zahl soils. Runoff is slow on the Bowbells soil and rapid on the Zahl soil. Available water capacity is high in both soils. Organic matter content is high in the Bowbells soil and moderate in the Zahl soil. Tilth is good in both soils.

Most areas are used for cultivated crops. These soils are well suited to small grain, flax, corn, and sunflowers and to grass-legume hay. The main concerns in managing cultivated areas are controlling soil blowing and water erosion. The hazard of soil blowing is slight

on the Bowbells soil and moderate on the Zahl soil. The hazard of water erosion is moderate on both soils. Grassed waterways in areas where runoff concentrates, field windbreaks, stripcropping, and a system of conservation tillage that leaves crop residue on the surface help to control soil blowing and water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

In areas where these soils are used for range, the important native forage plants are western wheatgrass, little bluestem, green needlegrass, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion and soil blowing.

The Bowbells soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Zahl soil is suited to only the most drought-tolerant species. Optimum growth, survival, and vigor are unlikely on the Zahl soil. Eliminating grasses and weeds before the trees and shrubs are planted and then controlling the regrowth of this ground cover can improve the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and to protect the seedlings from abrasion.

The land capability classification of the Bowbells soil is IIe, and that of the Zahl soil is IIIe. The productivity index of the unit for spring wheat is 74. The range site of the Bowbells soil is Silty, and that of the Zahl soil is Thin Upland.

96E—Zahl-Williams loams, 6 to 25 percent slopes. These deep, gently rolling to hilly, well drained soils are on moraines. The Zahl soil is on knolls, ridges, and shoulder slopes. The Williams soil is on summits and side slopes. Individual areas of this unit range from about 25 to more than 100 acres in size. They are about 45 to 65 percent Zahl soil and 30 to 50 percent Williams soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Zahl soil is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam.

Typically, the surface layer of the Williams soil is very dark brown loam about 7 inches thick. The subsoil is about 27 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In places the surface layer is black.

Included with these soils in mapping are small areas of the moderately well drained Bowbells soils in swales. These included soils make up about 5 to 25 percent of the unit. They have a surface layer that is dark to a depth of 16 inches or more.

Permeability is moderately slow in the Zahl and Williams soils. Runoff is very rapid. Available water capacity is high. Organic matter content is high in the Williams soil and moderate in the Zahl soil.

Most areas are used for range or wildlife habitat. Because of the slope and the hazard of erosion, these soils generally are unsuited to cultivated crops. They are best suited to range and pasture. The important native forage plants are western wheatgrass, green needlegrass, little bluestem, and needleandthread. Intermediate wheatgrass, smooth brome, and alfalfa are suitable hay and pasture plants. Water erosion and soil blowing are hazards, especially if the range or pasture is overgrazed. Maintaining an adequate cover of the important plants or of other suitable plants helps to control water erosion and soil blowing. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

These soils generally are unsuited to the trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs for esthetic or wildlife purposes can be planted if special treatment, such as hand or scalp planting, is applied.

The land capability classification of the Zahl soil is VIIe, and that of the Williams soil is VIe. The productivity index of the unit for spring wheat is 0. The range site of the Zahl soil is Thin Upland, and that of the Williams soil is Silty.

97F—Zahl-Max loams, 15 to 45 percent slopes. These deep, hilly to very steep, well drained soils are on moraines. The Zahl soil is on knolls, ridges, and shoulder slopes. The Max soil is on summits and side slopes. Individual areas of this unit range from about 25 to more than 100 acres in size. They are about 40 to 60 percent Zahl soil and 35 to 50 percent Max soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Zahl soil is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam.

Typically, the surface layer of the Max soil is very dark brown loam about 5 inches thick. The subsoil is

loam about 27 inches thick. It is dark brown in the upper part, brown in the next part, and light olive brown in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam.

Included with these soils in mapping are small areas of the moderately well drained Bowbells soils in swales. These included soils make up about 10 to 25 percent of the unit. They have a surface layer that is dark to a depth of 16 inches or more.

Permeability is moderately slow in the Zahl and Max soils. Runoff is very rapid. Available water capacity is high. Organic matter content is high in the Max soil and moderate in the Zahl soil.

Most areas are used for range or wildlife habitat. Because of the slope and the hazard of erosion, these soils generally are unsuited to cultivated crops. They are best suited to range and wildlife habitat. The important native forage plants are western wheatgrass, green needlegrass, little bluestem, and needleandthread. Water erosion and soil blowing are hazards, especially if the range is overgrazed. Maintaining an adequate cover of the important forage plants helps to control water erosion and soil blowing. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying.

These soils generally are unsuited to the trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs for esthetic or wildlife purposes can be planted if special treatment, such as hand or scalp planting, is applied.

The land capability classification of both soils is VIIe. The productivity index of the unit for spring wheat is 0. The range site of the Zahl soil is Thin Upland, and that of the Max soil is Silty.

98D—Williams-Zahl-Parnell complex, 0 to 15 percent slopes. These deep soils are on moraines. The nearly level to rolling, well drained Williams soil is on side slopes and summits. The undulating to rolling, well drained Zahl soil is on knolls, ridges, and shoulder slopes. The level, very poorly drained Parnell soil is in depressions. It is subject to ponding. Individual areas of this unit range from about 5 to more than 100 acres in size. They are about 30 to 40 percent Williams soil, 25 to 35 percent Zahl soil, and 20 to 25 percent Parnell soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Williams soil is very dark brown loam about 7 inches thick. The subsoil is about 27 inches thick. It is dark brown clay loam in the upper part and olive brown loam in the lower part. The substratum to a depth of about 60 inches is light olive brown, mottled loam. In places the surface layer is black.

Typically, the surface layer of the Zahl soil is very dark brown loam about 5 inches thick. The subsoil is olive brown loam about 15 inches thick. The substratum to a depth of about 60 inches is olive brown, mottled clay loam.

Typically, the Parnell soil has a black silty clay loam surface soil about 11 inches thick. The lower part is mottled. The subsoil is black silty clay loam about 30 inches thick. The next layer to a depth of about 60 inches is very dark gray, mottled clay. In places the soil contains less clay and is calcareous throughout.

Included with these soils in mapping are small areas of Bowbells, Vallers, and Wabek soils. These included soils make up about 5 to 25 percent of the unit. The well drained Bowbells soils are in swales. They have a surface layer that is dark to a depth of 16 inches or more. The poorly drained Vallers soils are on flats adjacent to the depressions. They have an accumulation of lime within a depth of 16 inches. The Wabek soils are on knolls and ridges. They have a gravelly substratum.

Permeability is moderately slow in the Williams and Zahl soils and slow in the Parnell soil. Runoff is rapid on the Williams and Zahl soils and ponded on the Parnell soil. Available water capacity is high in all three soils. Organic matter content is high in the Williams soil, very high in the Parnell soil, and moderate in the Zahl soil. A seasonal high water table is 2 feet above to 2 feet below the surface of the Parnell soil.

Most areas are used for range or wildlife habitat. Because of the complex slope configuration and because of the hazard of erosion on the Williams and Zahl soils, this unit generally is unsuited to cultivated crops. It is best suited to range and to wildlife habitat. The important native forage plants on the Williams and Zahl soils are western wheatgrass, green needlegrass, little bluestem, and needleandthread. On the Parnell soils they are slough sedge and rivergrass. Water erosion and soil blowing are hazards on the Williams and Zahl soils, especially if the range is overgrazed. Maintaining an adequate cover of the important forage plants helps to control water erosion and soil blowing. Gullies can form along cattle trails. A planned grazing system that controls the pattern of livestock traffic helps to prevent gullying. Trampling, compaction, and root shearing are problems, especially if the Parnell soil is grazed when it is wet. Grazing should be deferred during wet periods.

The Parnell soil and areas of ponded water provide feeding, breeding, and rearing sites for wetland wildlife. The main concerns in managing wetland wildlife habitat

are preventing siltation and maintaining the natural wetness.

These soils generally are unsuited to the trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs for esthetic or wildlife purposes can be planted if special treatment, such as hand or scalp planting or drainage of the Parnell soil, is applied.

The land capability classification of the Williams soil is IVe, that of the Zahl soil is VIe, and that of the Parnell soil is IIIw. The productivity index of the unit for spring wheat is 0. The range site of the Williams soil is Silty, that of the Zahl soil is Thin Upland, and that of the Parnell soil is Wetland.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 308,700 acres in the survey area, or about 42 percent of the total acreage, meets the soil requirements for prime farmland.

The map units in the survey area that are considered prime farmland are listed at the end of this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name on the following list. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

The map units that meet the requirements for prime farmland are:

8	Tonka silt loam (where drained)
9	Bearden silt loam
14	Barnes-Gardena loams, 1 to 3 percent slopes
15	Barnes-Svea loams, 1 to 3 percent slopes
15B	Barnes-Svea loams, 3 to 6 percent slopes
17B	Barnes-Buse loams, 3 to 6 percent slopes
22	Colvin silt loam (where drained)
24	Gardena loam, 0 to 3 percent slopes
25	Divide loam, 0 to 2 percent slopes
26B	Eckman-Gardena silt loams, 3 to 6 percent slopes
27B	Embden sandy loam, 1 to 6 percent slopes
29	Glyndon silt loam, 0 to 3 percent slopes
31	Edgeley loam, 1 to 3 percent slopes
31B	Edgeley loam, 3 to 6 percent slopes
35	Fordville loam, 1 to 3 percent slopes
42	Hamerly-Wyard loams, 0 to 3 percent slopes (where drained)
46	Ludden clay (where drained)
48	La Prairie loam
49	Lamoure silt loam (where drained)
50	Wyndmere-Tiffany fine sandy loams (where drained)
56	Overly silt loam
64	Sinai silty clay, 0 to 2 percent slopes
66	Spottswood loam, 1 to 3 percent slopes
70	Svea loam
72	Swenoda fine sandy loam, 1 to 3 percent slopes
74	Swenoda-Barnes complex, 1 to 3 percent slopes
90	Vallers loam (where drained)

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the limitations of each soil for specific land uses and to help to prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Prepared by Lyle Samson, agronomist, and Dean H. Stenseth, district conservationist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 73 percent of Dickey County is cultivated. In 1986, about 275,200 acres was used for close-grown crops, 76,500 acres for row crops, and 49,000 acres for forage crops *(6)*. During the period 1981 to 1985, the acreage used for close-grown crops averaged 229,800 acres per year. The acreage of summer fallow was 70,000 in 1983, 55,000 in 1984, and 65,000 in 1985. The acreage used for sunflower production is decreasing. It averaged 79,000 acres per year during the period 1981 to 1985, but it was 48,000 acres in 1985 and only 25,500 acres in 1986. The acreage used for corn and forage has been stable in recent years. In 1986, the acreages of the principal close-grown crops were as follows: spring wheat, 105,000 acres; durum wheat, 32,000 acres; winter wheat, 45,000 acres; barley, 60,000 acres; oats, 18,000 acres; rye, 7,200 acres; and flax, 8,000 acres. The main row crops were sunflowers and corn. Sunflowers were grown on 25,500 acres and corn on 51,000 acres. Alfalfa was grown on 29,000 acres and other hay crops on 20,000 acres. Small acreages were planted to mustard, buckwheat, sorghum, millet, and safflower.

The potential of the soils in Dickey County for increased production of food and fiber is good. This production is steadily increasing as the latest crop production technology is applied. This soil survey can facilitate the application of this technology.

The soils and climate of the county are suited to most of the crops that are commonly grown in the survey area. Crops that are not commonly grown but are suitable include lentils, potatoes, and rapeseed.

The principal management measures that help to ensure continuing productivity are those that control soil

blowing and water erosion, maintain or improve fertility and tilth, and result in proper utilization of soil moisture.

Water erosion and soil blowing reduce the productivity of the soils. If the surface layer is lost, most of the available plant nutrients also are lost. As a result, applications of fertilizer are needed to maintain adequate crop production.

Of equal concern is the loss of organic matter through erosion. Soil structure, water infiltration, available water capacity, and tilth are all negatively affected by this loss. As organic matter is lost and the subsoil is exposed and tilled, the remaining soil becomes increasingly susceptible to soil blowing and water erosion.

Soil blowing is a hazard on some of the soils in Dickey County. It is a severe hazard on the coarse textured and moderately coarse textured soils, including Arvilla, Clontarf, Embden, Hamar, Hecla, Kratka, Letcher, Maddock, Rosewood, Ruso, Serden, Stirum, Swenoda, Tiffany, Towner, Ulen, and Wyndmere soils.

Bearden, Colvin, Divide, Glyndon, Hamerly, Rosewood, Sakakawea, Ulen, Vallers, and Wyndmere soils have a relatively high content of lime and are susceptible to soil blowing in the spring if they have been bare throughout the winter. Because of freezing and thawing, soil structure breaks down, resulting in aggregates that are susceptible to movement. Nearly all soils can be damaged by soil blowing if they are left bare.

Water erosion is a severe hazard on moderately sloping and steeper soils, such as Barnes, Buse, Max, Williams, and Zahl soils. It also is a severe hazard on soils that have slopes that are gentle but long. The hazard is greatest when the surface is bare.

Conservation practices that control both soil blowing and water erosion are those that maintain a protective plant cover on the surface. Examples are conservation tillage systems that keep a protective amount of crop residue on the surface. Applications of herbicide can help to eliminate the need for summer fallow tillage. Cover crops also are effective in controlling both soil blowing and water erosion. Field windbreaks, annual wind barriers, and stripcropping help to control soil blowing. Grassed waterways, diversions, terraces, contour farming, field stripcropping across the slope, and a cropping sequence that includes grasses and legumes help to control water erosion. A management system that includes several measures is the best means of protecting the soil. For example, conservation tillage can control soil blowing during years when the amount of crop residue is adequate, but windbreaks are needed during years when the amount of residue is low.

Moisture at planting time is critical to the success of the crop during the growing season. In years when the amount of available soil moisture is low at planting time, crop production for the year is greatly reduced. Measures that reduce evaporation and runoff rates, improve the rate of water infiltration, and control weeds conserve moisture. Examples are stubble mulch, mulch tillage, no-till, stripcropping, cover crops, crop residue management, applications of fertilizer, and standing stubble and annual wind barriers, which trap snow. When fallow is used to carry moisture over to the next season, a cover of crop residue is essential during winter to prevent excessive moisture loss and erosion. Weed control helps to prevent depletion of the moisture supply.

Measures that improve fertility are needed on many soils. Examples are applications of commercial fertilizer or barnyard manure, green manure crops, and a cropping sequence that includes legumes.

Proper management of the soils includes measures that maintain good tilth. These measures are especially needed on soils that have a surface layer of silty clay loam, clay loam, or silty clay, such as Lamoure, Ludden, Parnell, Ryan, and Sinai soils. Measures that maintain the content of organic matter are also important. The traditional practice of clean-tilled summer fallow contributes to the loss of organic matter because it increases the susceptibility to erosion.

Management of Saline and Sodic Soils

Saline and sodic soils make up about 12 percent of Dickey County. Saline soils make up less than 1 percent of the county, or about 4,270 acres; sodic soils make up about 7 percent, or about 54,200 acres; and saline-sodic soils make up less than 4 percent, or about 26,800 acres.

Saline soils have a high concentration of soluble salts, or salts that dissolve in water. The saline soils in Dickey County are phases of the Colvin and Glyndon series.

Saline soils generally develop in areas of restricted drainage. Colvin soils, which are in areas adjacent to natural sloughs and waterways, are examples. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is reduced by plants and a surface cover. The plant roots use the soil water before it can reach the surface and before the salts accumulate. The surface cover prevents evaporation at the surface, the upward movement of water in the soil, and the concentration of salts at the surface.

Plants growing on saline soils absorb salts from the soil water. Excess amounts of certain salts may interfere with plant growth. High concentrations of some salts are toxic to certain plants. Some salts cause

nutritional imbalances or deficiencies by restricting the uptake or availability of certain plant nutrients. Detecting salinity by visual observations in the field is difficult. The salts are generally not visible during much of the growing season, particularly when the soil is moist. Flecks, threads, or masses of soluble salts are usually visible when the soil is dry. Laboratory analysis is needed to determine the actual degree of salinity in the soils.

Crop response, particularly during periods of soil moisture stress, is a useful indicator of the degree of salinity in saline soils. For instance, a small grain crop growing on saline soils tends to be stunted and has fewer tillers than small grain on nonsaline soils. Strongly saline soils are best suited to native grasses or to salt-tolerant introduced grasses. Slightly saline or moderately saline soils can produce salt-tolerant crops and forage. Barley is the most salt-tolerant of the small grains. Of the forage crops, tall wheatgrass, western wheatgrass, and alfalfa are salt-tolerant once they are established.

Sodic soils are characterized by a high content of exchangeable sodium, which adheres to the clay particles in the soil. The sodic soils in Dickey County are Aberdeen, Cavour, Cresbard, and Letcher soils. Locally, sodic soils are known as "black-alkali," "slick spots," "pan spots," or "gumbo."

Sodic soils develop in a complex pattern with very distinct microrelief. The physical and chemical properties of these soils differ markedly within very short distances. In many areas the distance between the sodic soils and the surrounding soils that have normal physical properties is only a few feet, perhaps 5 to 10 feet.

Sodic soils develop in areas of saline soils that contain large quantities of sodium salts. Over a long period, usually centuries, as the water table lowers, rainwater gradually leaches the salts from the surface to lower horizons. During this leaching process, the clay in the soil becomes saturated with sodium, disperses, and moves downward with the percolating water. As the moving clay concentrates, a dense, sodic subsoil forms. The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air. Examples of soils that have a dense, sodic subsoil are Cavour and Letcher soils.

As the leaching process continues, the sodium is gradually moved lower in the soil profile and eventually is carried below rooting depth. The result is a more manageable soil. Cresbard soils are examples. If the leaching process continues until nearly all of the sodium is removed from the profile, the soil eventually changes into a nonsodic soil. This change requires a long period, usually centuries *(5)*.

If plowed, sodic soils are characterized by a surface layer that is sticky when wet and hard and cloddy when dry. A crust forms easily at the surface. The chemical and physical properties of these soils are unfavorable for plant growth. The harmful effects of these properties on plants generally increase as the sodium content increases. The effects of the reduced amount of water available to plants are more harmful than the toxic effect of the sodium. The plants also are affected by depth to the dense subsoil.

Identification of sodic soils in cultivated fields commonly is difficult because many of the physical characteristics, such as columnar structure, have been altered by tillage. Crop response, particularly during periods of soil moisture stress, is a useful indicator of the level of alkalinity in a soil. Crops growing on soils that have varying amounts of sodium exhibit varying heights and stages of development. If the level of alkalinity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, the stage of crop growth, and soil moisture. A measure of the effect of alkalinity on vegetative growth is not necessarily a reliable measure of crop yields. In many areas the yields of barley and wheat are affected less than the vegetative growth of these crops.

The variability of sodic soils can cause management problems. The sodic soils that have salts within a depth of 16 inches, such as Exline and Miranda soils, are generally best suited to native grasses. The soils that have a dense, sodic subsoil near the surface are generally unsuited to small grain and sunflowers.

Timely tillage is important in areas of the leached sodic soils, such as Aberdeen and Cresbard soils. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soil puddles and crusts. If the soil is tilled when too dry, tillage and seeding implements cannot easily penetrate the soil. Deep plowing and chemical amendments can help to reclaim sodic soils, but they may not be feasible. To be effective, deep tillage should reach to the sodic subsoil and mix several inches of the underlying material with the subsoil and topsoil. Depending on the soil, tillage to a depth of 15 to 36 inches may be needed. Any reclamation of sodic soils is a long-term endeavor. Complete reclamation may never be achieved. Onsite investigation is needed to confirm the feasibility of deep tillage in a particular area.

Saline-sodic soils develop in areas of restricted drainage where salts rise with the water table but where some leaching downward of clay and some saturation with sodium are evident and a dense, sodic subsoil has formed. The saline-sodic soils in Dickey County are Exline, Harriet, Miranda, Ryan, and Stirum soils. The management needs and crop responses on these soils

are a combination of those on saline soils and those on sodic soils.

Additional information about the management or reclamation of saline and sodic soils is available from the Soil Conservation Service, the North Dakota Agricultural Experiment Station, and the Cooperative Extension Service.

Productivity Index

The productivity index is a relative rating of the ability of a particular map unit to produce a particular crop yield in comparison to other map units. The index ranges from 0, which indicates no yield, to 100, which indicates the highest yield. When the index is calculated, the similar and contrasting inclusions in a map unit are considered along with the major soils. In this survey a productivity index of 100 was considered equal to an average yield of 40 bushels per acre of spring wheat. Multiplying the productivity index by 40 and dividing the product by 100 converts the index number to a figure representing the expected average yield per acre. The map unit Svea-Cresbard loams, 0 to 2 percent slopes, for example, has a productivity index of 86. This number multiplied by 40 and then divided by 100 is 34, which is the expected average annual yield of spring wheat in bushels per acre for this map unit. (See table 5.)

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit *(14)*. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have

limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability class and subclass classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Prepared by Jeffrey L. Printz and A. Dean Chamrad, range conservationists, Soil Conservation Service.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

The native vegetation on rangeland consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. Generally, the plants are suitable for grazing and the plant cover is sufficiently productive to justify grazing. Cultural treatments generally are not used to increase forage production. The composition and production of the plant community are determined by soil, climate, topography, overstory canopy, and grazing management.

In 1986, approximately 139,000 acres in Dickey County, or about 19 percent of the total acreage, was rangeland. In areas where it is properly managed, this rangeland is similar to the presettlement prairie of the late 1800's and the early 1900's. Most of the rangeland is on loamy glacial till plains and moraines and sandy lacustrine plains. Much of it occurs as hilly to very steep, well drained or excessively drained soils (fig. 8) or as level and nearly level, moderately well drained to very poorly drained soils. The soils are generally unsuited or, at best, only poorly suited to cultivated crops.

In 1986, the farms and ranches in the county had about 60,000 head of cattle. Of that number, about 2,900 were milk cows *(6)*. Most of the ranches include a cow-calf operation. Some also include a yearling operation, which adds flexibility during periods of low or high forage production. On some ranches used as cow-calf operations, sheep are raised for improved income stability.

Because of the relatively short growing season, many farmers and ranchers have established cool-season tame pastures to supplement the forage produced on rangeland and to extend the grazing season in the spring and fall. Droughts of short duration are common. As a result, in many years cool-season pastures cannot be grazed in the fall. Generally, large quantities of hay and feed are needed because of the long winters. Hay was harvested on about 49,000 acres in 1986 *(6)*.

Range Site and Condition Classes

Soils vary in their capacity to produce grasses and other plants suitable for grazing. Soils that produce about the same kinds and amounts of forage are grouped into a range site.

Each range site has a distinctive potential plant community that is referred to as the climax vegetation. The climax vegetation is relatively stable and indicates what the range site is capable of producing. It reproduces itself annually and changes very little as long as the environment remains unchanged. On the prairie the climax vegetation consists of the kinds of plants that grew when the region was settled. It is generally the most productive combination of forage plants that can be grown on the site. When the site is improperly grazed, some of the climax vegetation decreases in proportion and some of it increases. Also, other plants that were not part of the native plant community invade the site.

Decreaser plants are the species that decline in quantity under close, continuous grazing. They generally are the tallest and most productive grasses and forbs and are the most palatable to livestock.

Increaser plants are the species that increase in quantity under close grazing at the expense of the decreaser species. They generally are the shorter plants or the ones less palatable to livestock.

Invader plants are species normally not included in the climax plant community because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site only after the extent of the climax vegetation has been reduced by heavy continual grazing. Most invader species have little grazing value.

Range condition classes indicate the present

Figure 8.—An area of Zahl and Williams soils. These soils on the steeper slopes are best suited to range production.

composition of the plant community on a range site in relation to the climax vegetation. Range condition is expressed as excellent, good, fair, or poor, depending on how much the present plant community resembles the natural plant community. *Excellent* indicates that 76 to 100 percent of the present plant community is the same as the climax vegetation; *good*, 51 to 75 percent; *fair*, 26 to 50 percent; and *poor*, 25 percent or less.

Potential forage production depends on the kind of range site. Current forage production depends on the range condition, plant vigor, and the amount of moisture available to the plants during the growing season.

Table 6 shows, for nearly all the soils in the county, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table also are important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase

in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as kind of plant, stage of growth, exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control the frequency, degree, and timing of grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition class somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Good range management keeps the range in excellent or good condition. Water is conserved, yields are improved, and soils are protected. The main management concern is recognizing the changes in the plant community that take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall, for example, may lead to the conclusion that the range is in good condition, when actually the plant cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been grazed closely for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover rapidly.

Rangeland can recover from prolonged overuse if the climax decreaser species have not been completely grazed out. If overgrazing is stopped, enough climax plants generally remain for proper grazing use, deferred grazing, and the grazing system to restore the rangeland to excellent condition. In areas where the climax plant community has been destroyed, range seeding can improve the condition. Seeding the proper climax species also can restore productive rangeland in areas of poor-quality cropland. Brush control, development of watering facilities, and other mechanical practices are needed to improve the potential of some rangeland. Good management is one of the most overlooked means of improving rangeland. Proper fencing is an important aspect of good management.

The following paragraphs describe the range sites in Dickey County. The names of these sites are Clayey, Claypan, Limy Subirrigated, Overflow, Saline Lowland, Sands, Sandy, Sandy Claypan, Shallow to Gravel, Silty, Subirrigated, Thin Claypan, Thin Sands, Thin Upland, Very Shallow, Wetland, and Wet Meadow.

Clayey range site. This site is dominated by a mixture of cool-season, mid grasses and an understory of warm- and cool-season, short grasses and sedges. The principal species are western wheatgrass, porcupinegrass, and green needlegrass. The understory plants are blue grama, prairie junegrass, Pennsylvania sedge, and other upland sedges. Forbs, such as western yarrow, scarlet globemallow, and gray sagewort, make up about 10 percent of the total herbage. The common woody plants are western snowberry and prairie rose.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, porcupinegrass, green needlegrass, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, fringed sagebrush, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, western ragweed, and fringed sagewort or in the invasion of Kentucky bluegrass.

Very few problems affect management of this site. The water infiltration rate is slow. As a result, an adequate cover of vegetation is needed to ensure that forage production is not reduced by runoff. Areas where the range is in fair condition can generally be restored to good or excellent condition by good grazing management if the remnant climax species remain on the site in sufficient numbers and are evenly distributed.

Claypan range site. The climax vegetation on this site is primarily a mixture of short and mid grasses, sedges, and forbs. The principal species are western wheatgrass, green needlegrass, needleandthread, and blue grama. Other species are prairie junegrass, bearded wheatgrass, and upland sedges. The common forbs are scarlet globemallow, silver scurfpea, and rush skeletonplant. Fringed sagebrush is a common shrub on this site.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and

western wheatgrass. The plants that increase in abundance under these conditions are inland saltgrass, blue grama, Sandberg bluegrass, upland sedges, and fringed sagebrush. Further deterioration results in a dominance of blue grama, inland saltgrass, upland sedges, fringed sagebrush, and unpalatable forbs.

This site is easily damaged by overgrazing. Because of a dense subsoil and the content of salts in the soil, reestablishing the vegetation is difficult in denuded areas. Careful management that maintains the abundance of the naturally dominant plants is the best way to maintain forage production and protect the soil from water erosion.

Limy Subirrigated range site. Warm-season, tall and mid grasses dominate this site. The principal species are little bluestem, big bluestem, indiangrass, and switchgrass. Other species are slim sedge, western wheatgrass, fescue sedge, and Baltic rush. The common forbs are Maximilian sunflower, stiff sunflower, American licorice, and Missouri goldenrod. They make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, indiangrass, switchgrass, Maximilian sunflower, and stiff sunflower. Little bluestem initially increases in abundance under these conditions, but it eventually decreases. Further deterioration results in a dominance of Kentucky bluegrass, Baltic rush, common spikerush, and low-growing sedges, annual grasses, and annual forbs.

Because of the high percentage of warm-season grasses, this site can provide high-quality forage late in the growing season. In areas where the plant community has deteriorated from its potential, proper grazing use and deferment of grazing during the growing season or a planned grazing system can restore the site. In areas where the potential plant community has been destroyed by cultivation or by extremely severe overuse, range seeding can reestablish the major grass species.

Overflow range site. Tall and mid grasses are dominant when this site is in excellent condition. The principal species are big bluestem, green needlegrass, western wheatgrass, and prairie cordgrass. Other species are porcupinegrass, switchgrass, fescue sedge, and prairie dropseed. Several forbs, such as Maximilian sunflower, soft goldenrod, gray sagewort, and heath aster, make up about 10 percent of the total herbage. Several woody plants, such as western snowberry, fringed sagebrush, and common chokecherry, commonly grow on the site, depending on the position on the landscape. They may make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, prairie cordgrass, green needlegrass, prairie dropseed, and switchgrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, Pennsylvania sedge, and fescue sedge. Further deterioration results in a dominance of blue grama, sedges, Kentucky bluegrass, and unpalatable forbs.

Because of its position on the landscape, this site is frequently overgrazed. Separating this site by fencing generally is not feasible because of the small size or the irregular shape of the areas. As a result of flooding and the runoff received by these areas, the site is very productive when properly managed. A planned grazing system and proper grazing use can restore the site and maintain a high level of productivity. Reseeding is needed in areas that have been farmed. In areas where shrubs dominate, brush control can help to restore productivity.

Saline Lowland range site. Salt-tolerant, mid grasses dominate this site. The principal species are Nuttall alkaligrass, inland saltgrass, alkali cordgrass, western wheatgrass, and slender wheatgrass. Other salt-tolerant species are alkali muhly, plains bluegrass, foxtail barley, and prairie bulrush. Forbs, such as western dock, silverweed cinquefoil, and Pursh seepweed, make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as Nuttall alkaligrass, slender wheatgrass, western wheatgrass, and alkali cordgrass. The plants that increase in abundance under these conditions are inland saltgrass, alkali muhly, foxtail barley, and mat muhly. Further deterioration results in a dominance of inland saltgrass, foxtail barley, silverweed cinquefoil, and western dock.

A high content of salts and a restricted available water capacity limit forage production on this site. Careful management of the adapted desirable salt-tolerant plants can maintain good forage production. If the plant community has been severely damaged, however, the site recovers slowly. Soil blowing and water erosion are hazards in denuded areas. Stock water ponds on this site frequently contain salty water. If feasible, alternative water sources should be developed.

Sands range site. The principal grasses on this site are prairie sandreed, needleandthread, sand bluestem,

and porcupinegrass. Other species are blue grama, prairie junegrass, little bluestem, sand dropseed, western wheatgrass, and upland sedges. Forbs such as purple prairieclover, green sagewort, stiff goldenrod, and blacksamson make up about 10 percent of the total herbage. This site has a small number of woody species, such as prairie rose, western snowberry, and leadplant amorpha.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie sandreed, needleandthread, little bluestem, sand bluestem, and leadplant amorpha. The plants that increase in abundance under these conditions are sand dropseed, blue grama, upland sedges, and several forbs. Further deterioration results in a dominance of blue grama, upland sedges, and unpalatable forbs, such as fringed sagewort and gray sagewort.

A low or very low available water capacity and the hazard of soil blowing are concerns in managing this site. Measures that minimize the formation of livestock trails and that do not allow the animals to concentrate in an area for too long a time are needed. In severely overgrazed areas, blowouts are common. On large blowouts, shaping, seeding, and mulching are needed before the climax vegetation can be reestablished. The vegetation in areas where the site is in fair or poor condition responds rapidly to improved grazing management.

Sandy range site. The principal grasses on this site are needleandthread, porcupinegrass, and prairie sandreed. Other species are prairie junegrass, blue grama, western wheatgrass, green needlegrass, and upland sedges. The site generally has a number of early season forbs, such as western yarrow, green sagewort, and soft goldenrod. Woody plants, such as western snowberry and leadplant amorpha, make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as needleandthread, green needlegrass, prairie sandreed, and leadplant amorpha. The plants that increase in abundance under these conditions are blue grama, upland sedges, sand dropseed, and several forbs. Further deterioration results in a dominance of blue grama, upland sedges, and unpalatable forbs, such as western yarrow, green sagewort, and gray sagewort.

A moderate available water capacity is a concern in managing this site. Also, soil blowing is a hazard in denuded areas. Management that maintains the abundance of the key species results in a natural plant community that provides excellent forage for livestock and a protective plant cover.

Sandy Claypan range site. Short grasses dominate this site. The principal species are western wheatgrass, needleandthread, and blue grama. Other species are sun sedge, inland saltgrass, other upland sedges, and a small number of perennial forbs. The common woody plants are fringed sagebrush and western snowberry.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass and needleandthread. The plants that increase in abundance under these conditions are blue grama, inland saltgrass, upland sedges, and fringed sagebrush. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagebrush, annual forbs, and annual grasses.

Forage production varies on this site. The soils have a dense, sodic subsoil and a limited available water capacity. The site is fragile, and the natural plant community can deteriorate rapidly. Management that maintains a protective plant cover is needed to control erosion.

Shallow to Gravel range site. A mixture of cool- and warm-season, mid grasses dominates this site. The principal species are western wheatgrass, needleandthread, green needlegrass, and blue grama. Other species are plains muhly, prairie junegrass, porcupinegrass, and upland sedges. Forbs make up about 10 percent of the total herbage. The site has only a small number of woody plants.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, western wheatgrass, plains muhly, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, red threeawn, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, Kentucky bluegrass, unpalatable forbs, and fringed sagebrush.

Because of a limited available water capacity, forage production is limited on this site. It varies, depending on rainfall patterns. The site is fragile, and the plant community can deteriorate rapidly. Because of the limited amount of available water, the plant community should be kept near its potential and the vigor of the desirable plants maintained in order to optimize the use of available moisture.

Silty range site. Cool-season, mid grasses dominate this site. The principal species are western wheatgrass, porcupinegrass, needleandthread, green needlegrass, and bearded wheatgrass. Other species are prairie junegrass, prairie dropseed, blue grama, and upland sedges. Forbs make up about 15 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, prairie dropseed, and porcupinegrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, threadleaf sedge, needleleaf sedge, and fringed sagebrush. Further deterioration results in a dominance of blue grama, threadleaf sedge, needleleaf sedge, Kentucky bluegrass, and varying amounts of fringed sagebrush, gray sagewort, and other forbs.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form along livestock trails. Fencing and improved grazing management help to prevent gullying. They also are beneficial in areas where gullies have already formed. Areas where the site is in fair condition generally can be restored to good or excellent condition by good management. In some areas brush control is needed.

Subirrigated range site. Tall grasses dominate this site. The principal species are big bluestem, switchgrass, prairie cordgrass, little bluestem, and northern reedgrass. Other species are indiangrass, western wheatgrass, tall dropseed, and slender wheatgrass. The site has a small number of sedges and rushes. A variety of forbs, such as Maximilian sunflower, common wild mint, and tall goldenrod, makes up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, switchgrass, prairie cordgrass, northern reedgrass, indiangrass, and little bluestem. The plants that increase in abundance under these conditions are mat muhly, fowl bluegrass, Baltic rush, common spikerush, and undesirable forbs. Further deterioration results in a dominance of Kentucky bluegrass, short grasses, and grasslike plants and undesirable forbs.

Because of the high percentage of warm-season grasses, this site can provide high-quality forage late in the growing season. In areas where the plant community has deteriorated from its potential, deferment of grazing during the growing season or a planned grazing system and proper grazing use can restore the site. In areas where the potential plant community has been destroyed by cultivation or by extremely severe overuse, range seeding can reestablish the major grass species.

Thin Claypan range site. Short grasses dominate this site. The principal species are western wheatgrass, blue grama, Nuttall alkaligrass, inland saltgrass, and Sandberg bluegrass. Other species are prairie junegrass, needleandthread, Nuttall alkaligrass, alkali muhly, and needleleaf sedge. Forbs make up about 5 percent of the total herbage. The common woody plants are fringed sagebrush and broom snakeweed.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, Nuttall alkaligrass, prairie junegrass, and needleandthread. Plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, and alkali muhly. Further deterioration results in a dominance of short grasses, sedges, fringed sagebrush, broom snakeweed, and undesirable forbs.

Because of a high content of salts near the surface, productivity is quite low on this site. The site produces good quality forage for cattle only if properly managed. If the site is in poor or fair condition, recovery is quite slow because of the salts and a dense, alkali subsoil. Stock water pits should not be constructed on this site because the water is likely to be salty. Careful management can maintain or restore the site to good or excellent condition. If the vegetation has been destroyed by cultivation or the site denuded, range seeding can restore the climax vegetation. Good seeding techniques are needed.

Thin Sands range site. Cool- and warm-season, mid grasses dominate this site. The principal species are prairie sandreed, needleandthread, and sand bluestem. Other species are blue grama, little bluestem, sand dropseed, Canada wildrye, green needlegrass, upland sedges, and prairie junegrass. Forbs make up about 15 percent of the total herbage. The site has a small number of woody plants, such as leadplant amorpha and fringed sagebrush.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie sandreed, needleandthread, and sand bluestem. The plants that increase in abundance under these conditions are sand dropseed, blue grama, and upland sedges. Further deterioration results in a dominance of upland sedges, Kentucky bluegrass, blue grama, and several unpalatable forbs.

This site is very fragile. It is subject to soil blowing if the vegetation is damaged by overgrazing or the soil is denuded. Blowouts are common in overgrazed areas. Good management can keep the site in good or excellent condition. In areas where the site is in poor or fair condition, careful management can restore productivity. A planned grazing system that includes adequate rest periods between the grazing periods in conjunction with proper grazing use is one of the better ways of managing this site.

Thin Upland range site. Cool- and warm-season, mid grasses dominate this site. The principal species are little bluestem, needleandthread, western wheatgrass, and blue grama. Other species are plains muhly, sideoats grama, green needlegrass, porcupinegrass, and upland sedges. Forbs make up about 10 percent of the herbage. The site has a small number of woody plants, such as silverberry and western snowberry.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as little bluestem, needleandthread, western wheatgrass, and sideoats grama. The plants that increase in abundance under these conditions are blue grama, red threeawn, upland sedges, and unpalatable forbs. Further deterioration results in a dominance of blue grama, red threeawn, Kentucky bluegrass, upland sedges, and fringed sagebrush.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form along livestock trails. Fencing and improved grazing management help to prevent gullying. They also are beneficial in areas where gullies have already formed. Soil blowing is a problem in denuded areas. Areas where the site is in fair condition generally can be restored to good or excellent condition by good management. In some areas brush control is needed.

Very Shallow range site. This site has a mixture of cool- and warm-season, mid and short grasses. The principal species are needleandthread, western wheatgrass, blue grama, and plains muhly. Other species are prairie junegrass, red threeawn, sideoats grama, and upland sedges. Forbs and woody plants make up about 15 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as needleandthread, western wheatgrass, sideoats grama, and plains muhly. The plants that increase in abundance under these conditions are blue grama, red threeawn, sand dropseed, and upland sedges. Further deterioration results in a dominance of red threeawn, upland sedges, and undesirable forbs and shrubs.

Available water capacity is very low on this site. Also, water erosion is a hazard in the more sloping areas. Gullies can readily form along cattle trails and in denuded areas. The site is frequently overgrazed. Once it is in fair or poor condition, it recovers slowly because of the very low available water capacity. Productivity can be maintained by careful management of the cool-season mid grasses and by cross fencing, which helps to control livestock traffic patterns.

Wetland range site. Tall grasses dominate this site. The principal species are rivergrass, prairie cordgrass, northern reedgrass, slough sedge, and slim sedge. Other species are American mannagrass, American sloughgrass, Baltic rush, and common spikesedge. Common forbs are longroot smartweed and waterparsnip.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as rivergrass, slough sedge, prairie cordgrass, and northern reedgrass. The plants that increase in abundance under these conditions are slim sedge, Baltic rush, common spikesedge, and American sloughgrass. Further deterioration results in a dominance of Baltic rush, common spikesedge, and Mexican dock.

This site is easily damaged when it is wet. Grazing during wet periods results in soil compaction, trampling, and root shearing. Livestock are attracted to this site because of the supply of moisture. A planned grazing system and deferment of grazing when the site is wet help to maintain the climax vegetation and preserve the value of the site as wetland wildlife habitat.

Wet Meadow range site. Mid sedges dominate this site. The principal species are slim sedge, wooly sedge, fescue sedge, prairie cordgrass, and northern reedgrass. Other species are Baltic rush, common spikerush, fowl bluegrass, and switchgrass. Common forbs are Rydberg sunflower, tall white aster, and common wild mint. Forbs make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of slim sedge, wooly sedge, northern reedgrass, prairie cordgrass, and switchgrass. The plants that increase in abundance under these conditions are fescue sedge, common spikerush, Baltic rush, mat muhly, and fowl bluegrass. Further deterioration results in a dominance of low-growing sedges, short grasses, western dock, and Canada thistle.

This site is easily damaged when it is wet. Grazing during wet periods results in compaction, trampling, and root shearing. Livestock are attracted to this site because of the supply of moisture. A planned grazing system with proper fencing helps to maintain the climax vegetation. The site is an excellent source of quality hay.

Woodland, Windbreaks, and Environmental Plantings

Prepared by Bruce C. Wight, forester, Soil Conservation Service.

Dickey County has approximately 1,200 acres of native woodland *(8)*. Most of this woodland is

concentrated in the woody draws along the eastern face of the Missouri escarpment in the western part of the county. Trees and shrubs also grow to a limited degree along the James and Maple Rivers and on the fringe of wetlands in the western part of the county. The woodland in the woody draws is primarily in areas of Bowbells, Williams, and Zahl soils. The woodland on bottom land is mostly in areas of La Prairie soils. The woodland on the fringe of the wetlands is mostly in areas of Vallers soils.

The bottom-land forest type is primarily American elm, green ash, boxelder, and various willow species. Other less common species include cottonwood, common chokecherry, and redosier dogwood. Green ash is the dominant woodland type in the woody draws of the Missouri escarpment. Other trees and shrubs associated with the green ash include American elm, hackberry, hawthorn, American plum, chokecherry, juneberry, Woods rose, snowberry, serviceberry, and silver buffaloberry. The shrubs predominate in the upper reaches of the woody draws. The principal species in the woodland along the edges of the wetlands are cottonwood, various species of willow, and redosier dogwood.

Early settlers used the trees for fuel, lumber, and fenceposts. Currently, there is a renewed interest in using trees for fuel. The principal uses of trees, however, are for protection and esthetic purposes. The trees protect the soil, homes, livestock, wildlife, and watersheds.

Windbreaks have been planted in Dickey County since the early days of settlement. Some of the early plantings were made as a result of the Timber Culture Act, under which 160 acres of land was granted to a homesteader who planted 10 acres of trees. Most of the early plantings were made to protect farmsteads and livestock. In the 1930's, approximately 2,085 acres was planted to trees and shrubs under the Prairie States Forestry Project of the United States Department of Agriculture, Forest Service (USDA-FS).

Since the 1930's, more than 5 million trees have been planted on about 6,500 acres by county farmers and landowners assisted by the Soil Conservation Service and the James River Soil Conservation District. Trees and shrubs are still needed around numerous farmsteads, but the major need is for windbreaks that help to protect soils that are highly susceptible to soil blowing.

Before a windbreak is established, the purpose of the planting, the suitability of the soil for the various species of trees and shrubs, the location and design of the windbreak, and the availability of a source of hardy and adapted trees and shrubs should be considered. If these elements are not considered, a poor or unsuccessful windbreak may result.

The establishment of a windbreak or an environmental planting and the growth of the trees and shrubs also depend on suitable site preparation and adequate maintenance after the trees and shrubs are planted. Grasses and weeds should be eliminated before the planting is made, and the competing vegetative regrowth of the ground cover should be controlled throughout the life of the windbreak. Some replanting of the trees and shrubs may be necessary during the first 2 years after planting.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Prepared by David D. Dewald, biologist, Soil Conservation Service.

The recreational resources in Dickey County are limited. Hunting, fishing, and camping are the main recreational opportunities available to the residents of the survey area. Fishing and some primitive camping are available at Wilson Dam and Pheasant Lake and on the James River. Northern pike, walleyed pike, bluegill, crappie, yellow perch, rainbow trout, largemouth bass, and bullhead are the main game fish species.

Two towns in the survey area have picnicking facilities and limited camping facilities. Whitestone

Battlefield State Park is operated by the county and has a picnic area.

Public hunting is available on the approximately 8,900 acres of waterfowl production areas managed by the Fish and Wildlife Service and the 2,750 acres of wildlife management areas managed by the North Dakota Game and Fish Department. About 3,660 acres of state school land is located in the survey area and is open to public access. Many private landowners grant permission to hunt on their land. One private hunting lodge is operated in the county.

Additional recreational activities in the survey area include hiking, birdwatching, and cross-country skiing. Johnson Gulch Wildlife Management Area has horseback riding trails and picnic areas and offers hunting opportunities.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Prepared by David D. Dewald, biologist, Soil Conservation Service.

Dickey County is located in the prairie pothole region of North Dakota. The survey area provides a diverse habitat for wildlife. Agricultural activity has reduced the quality and quantity of rangeland and wetland wildlife habitat but has increased the amount of openland wildlife habitat. About 19 percent of the original rangeland habitat remains, and native woodland provides wildlife habitat in less than 1 percent of the county. Wildlife habitat and the diversity of wildlife species are enhanced by the remaining wetlands, approximately 1,200 acres of remaining native woodland, and approximately 6,500 acres of tree shelterbelts planted by farmers and landowners since the 1930's.

Drainage of hydric soils has removed approximately 30 percent of the wetlands in the county. The remaining wetlands provide habitat for waterfowl and furbearers.

Private landowners have protected approximately 23,950 acres of wetlands by conveying their drainage rights to the Federal government through the Small Wetlands Acquisition Program. Conservation tillage systems in areas used for crop production have

increased the amount of food and cover available for migratory waterfowl and resident wildlife.

Public lands provide excellent wildlife habitat. The U.S. Fish and Wildlife Service manages about 8,900 acres as waterfowl production areas and an additional 3,460 acres as easement refuges, which limit hunting and provide wetland habitat. The North Dakota Game and Fish Department manages approximately 2,750 acres of state-owned wildlife management areas.

Important game bird species in the survey area are gray partridge, ring-necked pheasant, ducks, geese, mourning dove, and sharptail grouse. Mammals that are hunted include red fox, white-tailed deer, muskrat, mink, raccoon, badger, cottontail rabbit, and white-tailed jackrabbit.

A limited variety of fish species inhabit the survey area. Northern pike, walleyed pike, yellow perch, largemouth bass, bullhead, bluegill, and crappie are the major species. Most of the fish are in public lakes and the James River; however, some are in the scattered small ponds in the county. The potential for developing additional fishery resources is limited.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are corn, wheat, oats, sunflowers, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are intermediate and tall wheatgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, western wheatgrass, and blue grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are common chokecherry, buffaloberry, snowberry, and juneberry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, common reedgrass, saltgrass, prairie cordgrass, bulrushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface

stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include gray partridge, pheasant, western meadowlark, lark bunting, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sharptail sage grouse, western meadowlark, and davids sparrow.

About 108,800 acres in the county, or nearly 15 percent of the total land area, meets the requirements for hydric soils. The map units in the survey area that generally display hydric conditions are listed at the end of this paragraph. They are considered hydric soils unless they have been artificially drained or otherwise so altered that they no longer support a predominance of hydrophytic vegetation. The soil maps do not identify the drained areas. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4, and the location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." Most of the wetland wildlife habitat in the survey area is in areas of hydric soils.

4	Rosewood fine sandy loam
6	Parnell silty clay loam
7	Southam silt loam
8	Tonka silt loam
13	Rosewood fine sandy loam, wet
22	Colvin silt loam
23	Colvin silt loam, wet
34	Hecla-Hamar loamy fine sands, 0 to 3 percent slopes (Hamar part)
39	Hamar loamy fine sand
40	Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes (Tonka and Parnell parts)
41	Colvin silt loam, saline
44	Harriet loam
46	Ludden clay
49	Lamoure silt loam
50	Wyndmere-Tiffany fine sandy loams (Tiffany part)
51	Kratka-Letcher fine sandy loams, 0 to 2 percent slopes (Kratka part)
57	Ryan-Ludden complex
65B	Serden-Hamar complex, 0 to 6 percent slopes (Hamar part)
67	Stirum fine sandy loam
68	Stirum-Letcher fine sandy loams (Stirum part)
79	Ulen-Hamar complex (Hamar part)
90	Vallers loam
98D	Williams-Zahl-Parnell complex, 0 to 15 percent slopes (Parnell part)

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt

fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. The depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are

favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable*

source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The

limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in

the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a

sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the

extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the North Dakota State Highway Department Laboratory.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(15)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that has a frigid temperature regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Udic* identifies the subgroup that has a udic moisture regime. An example is Udic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, Udic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(13)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(15)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aberdeen Series

The Aberdeen series consists of deep, moderately well drained, slowly permeable, sodic soils on lake plains. These soils formed in glaciolacustrine sediments. Slope is 0 to 1 percent.

Typical pedon of Aberdeen silt loam, in an area of Overly-Aberdeen silt loams; 320 feet south and 140 feet east of the northwest corner of sec. 19, T. 130 N., R. 59 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, sticky and plastic; common very fine and few fine roots; slightly acid; abrupt smooth boundary.

B/E—9 to 13 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry (B); moderate medium prismatic structure parting to moderate medium angular blocky; soft, friable, slightly sticky and slightly plastic; gray (10YR 5/1) silt coatings on faces of peds (E); common very fine roots; neutral; clear wavy boundary.

Bt—13 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong prismatic structure parting to strong coarse angular blocky; hard, firm, sticky and plastic; common very fine roots; common faint black (N 2/0) clay films on faces of peds; bleached sand grains on faces of peds; neutral; gradual wavy boundary.

Bky—22 to 27 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to moderate medium angular blocky; hard, friable, sticky and plastic; few very fine roots; common masses of gypsum; common fine irregular filaments and threads of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—27 to 31 inches; olive brown (2.5Y 4/4) silt loam, light yellowish brown (2.5Y 6/4) dry; common medium prominent brownish yellow (10YR 6/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; moderately alkaline; clear wavy boundary.

C2—31 to 60 inches; olive brown (2.5Y 4/4) silt loam, pale yellow (2.5Y 8/4) dry; common medium prominent brownish yellow (10YR 6/6) mottles; massive; hard, friable, sticky and plastic; few very fine roots; common fine irregular soft masses and common fine irregular filaments and threads of lime; violent effervescence; moderately alkaline.

The depth to lime ranges from 16 to 32 inches. The A horizon has value of 2 or 3 (3 or 4 dry). The Bt horizon has value of 3 to 5 dry and chroma of 1 to 3. It is silty clay, silty clay loam, or clay. Some pedons have a Btk horizon. The Bky horizon has hue of 2.5Y or 5Y, value of 3 to 5 (5 to 7 dry), and chroma of 1 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 8 dry), and chroma of 2 to 4. It is silt loam or silty clay loam.

Arvilla Series

The Arvilla series consists of deep, somewhat excessively drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slope ranges from 1 to 6 percent.

Typical pedon of Arvilla fine sandy loam, 1 to 6 percent slopes, 1,550 feet east and 180 feet north of the southwest corner of sec. 16, T. 131 N., R. 59 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine roots; neutral; abrupt smooth boundary.

Bw1—9 to 15 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; clear wavy boundary.

Bw2—15 to 19 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; abrupt wavy boundary.

2C—19 to 60 inches; dark grayish brown (2.5Y 4/2), stratified coarse sand and gravelly coarse sand, grayish brown (2.5Y 5/2) dry; single grain; loose, nonsticky and nonplastic; about 15 percent gravel; lime coatings on undersides of pebbles in the upper part; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to sand and gravel range from 14 to 25 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has value of 2 to 4 (3 to 5 dry) and chroma of 1 to 3. The 2C horizon ranges from 5 to 35 percent gravel.

Barnes Series

The Barnes series consists of deep, well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 1 to 25 percent.

Typical pedon of Barnes loam, in an area of Barnes-

Svea loams, 1 to 3 percent slopes; 350 feet west and 2,500 feet north of the southeast corner of sec. 18, T. 130 N., R. 60 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine pores; about 2 percent gravel; mildly alkaline; abrupt smooth boundary.

Bw—8 to 15 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common pores; about 2 percent gravel; mildly alkaline; clear wavy boundary.

Bk—15 to 26 inches; olive brown (2.5Y 4/4) loam, light olive brown (2.5Y 5/4) dry; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; few roots; common pores; about 2 percent gravel; few fine iron concretions; common fine irregularly shaped small masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—26 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 5/6) relict mottles; massive; hard, firm, slightly sticky and slightly plastic; about 2 percent gravel; common fine irregularly shaped small masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 15 inches. The content of gravel ranges from 1 to 10 percent throughout the profile.

The A horizon generally has value of 2 or 3 (3 or 4 dry) and chroma of 1, but in some pedons it has dry chroma of 2 in the lower part. The Bw horizon has hue of 2.5Y or 10YR, value of 2 to 5 (3 to 6 dry), and chroma of 2 to 4. It is loam or clay loam. The Bk horizon has hue of 2.5Y or 10YR, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is loam or clay loam. The C horizon has value of 4 to 6 (5 to 7 dry) and chroma of 2 to 4. It has few to many mottles.

Bearden Series

The Bearden series consists of deep, somewhat poorly drained, moderately slowly permeable, highly calcareous soils on lake plains. These soils formed in glaciolacustrine sediments. Slope is 0 to 1 percent.

Typical pedon of Bearden silt loam, 80 feet west and 900 feet north of the southeast corner of sec. 27, T. 129 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; few fine irregularly shaped soft masses of lime; slight effervescence; mildly alkaline; clear wavy boundary.

Bk1—13 to 28 inches; dark grayish brown (2.5Y 4/2) silty clay loam, gray (10YR 6/1) dry; moderate medium prismatic structure parting to weak fine subangular blocky; slightly hard, friable, sticky and plastic; common very fine roots; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—28 to 36 inches; light olive brown (2.5Y 5/4) silty clay loam, pale yellow (2.5Y 7/4) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few fine roots; many medium irregularly shaped soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—36 to 48 inches; light olive brown (2.5Y 5/4) and light olive gray (5Y 6/2) silty clay loam, pale yellow (2.5Y 7/4) and white (5Y 8/1) dry; massive; hard, firm, sticky and plastic; few fine roots; many medium irregularly shaped soft masses of lime; strong effervescence; moderately alkaline; clear wavy boundary.

C2—48 to 60 inches; olive (5Y 5/4) and light gray (N 7/0) silty clay loam, pale yellow (5Y 7/4) and white (N 8/0) dry; massive; hard, friable, sticky and plastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. The A horizon has hue of 10YR or 2.5Y, or it is neutral in hue and has value of 2 or 3 (3 to 5 dry) and chroma of 0 to 2. The Bk horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5 (5 to 7 dry), and chroma of 1 to 4. It is silt loam or silty clay loam. The C horizon has value of 4 to 7 (5 to 8 dry). In some pedons it has few or common faint to prominent mottles.

Bowbells Series

The Bowbells series consists of deep, moderately well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till and alluvium. Slope ranges from 3 to 6 percent.

Typical pedon of Bowbells loam, in an area of Williams-Bowbells loams, 3 to 6 percent slopes; 980 feet north and 2,340 feet west of the southeast corner of sec. 5, T. 130 N., R. 65 W.

A—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; about 1 percent gravel; neutral; clear wavy boundary.

Bt1—6 to 14 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine roots; many fine pores; few distinct clay films on faces of peds; about 1 percent gravel; neutral; gradual wavy boundary.

Bt2—14 to 19 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine roots; common fine pores; common distinct clay films on faces of peds; neutral; clear wavy boundary.

Bk—19 to 33 inches; light yellowish brown (2.5Y 6/4) loam, light brownish gray (2.5Y 6/2) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; about 2 percent gravel; common fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—33 to 60 inches; light olive brown (2.5Y 5/4) loam, light gray (2.5Y 7/2) dry; few medium prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; about 2 percent gravel; few fine soft masses of lime; strong effervescence; moderately alkaline.

The content of gravel ranges from 1 to 5 percent throughout the profile. The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 6 dry), and chroma of 2 or 3. It is clay loam or loam. The C horizon has value of 3 to 5 (4 to 7 dry). It is loam or clay loam.

Brantford Series

The Brantford series consists of deep, well drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 1 to 9 percent.

Typical pedon of Brantford loam, in an area of Brantford-Vang loams, 1 to 3 percent slopes; 1,000 feet south and 1,320 feet east of the northwest corner of sec. 34, T. 132 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; neutral; abrupt smooth boundary.

Bw—8 to 15 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; neutral; clear wavy boundary.

2C1—15 to 22 inches; dark grayish brown (10YR 4/2) gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, soft, nonsticky and nonplastic; few fine roots; about 20 percent shale gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

2C2—22 to 60 inches; dark brown (7.5YR 3/4) and pale brown (10YR 6/3) very gravelly coarse sand; single grain; loose, nonsticky and nonplastic; about 40 percent shale gravel; slight effervescence; moderately alkaline.

The depth to sand and gravel ranges from 14 to 20 inches. The thickness of the mollic epipedon ranges from 7 to 16 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 3 or 4 (3 to 5 dry), and chroma of 1 to 3. It is loam or gravelly loam. The 2C horizon is gravelly coarse sand, gravelly sand, very gravelly sand, or very gravelly coarse sand. It ranges from 15 to 50 percent shale gravel.

Buse Series

The Buse series consists of deep, well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 3 to 25 percent.

Typical pedon of Buse loam, in an area of Buse-Barnes loams, 9 to 25 percent slopes; 400 feet south and 240 feet west of the northeast corner of sec. 3, T. 131 N., R. 63 W.

A—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; about 2 percent gravel; slight effervescence; moderately

alkaline; clear smooth boundary.

Bk—6 to 17 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; about 2 percent gravel; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C—17 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; about 5 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 10 inches. The content of gravel ranges from 2 to 10 percent throughout the profile.

The A horizon generally has value of 2 or 3 (3 to 5 dry) and chroma of 1, but in some pedons it has dry chroma of 2 in the lower part. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6 (4 to 7 dry), and chroma of 2 to 4. The C horizon has hue of 2.5Y or 10YR, value of 4 to 6 (4 to 7 dry), and chroma of 2 to 4. It is loam or clay loam.

Cavour Series

The Cavour series consists of deep, well drained, very slowly permeable, alkali soils on till plains. These soils formed in glacial till. Slope ranges from 1 to 6 percent.

Typical pedon of Cavour loam, in an area of Cavour-Miranda loams, 1 to 3 percent slopes; 2,000 feet north and 90 feet east of the southwest corner of sec. 8, T. 131 N., R. 64 W.

Ap—0 to 5 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

A—5 to 9 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; strong medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; about 1 percent gravel; neutral; clear smooth boundary.

E—9 to 12 inches; dark gray (10YR 4/1) loam, gray (10YR 6/1) dry; strong coarse subangular blocky structure parting to weak medium platy; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; about 1 percent gravel; neutral; abrupt wavy boundary.

Bt—12 to 19 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; strong coarse columnar structure parting to strong coarse angular blocky; extremely hard, very firm, sticky and plastic; common very fine and few fine roots; common faint clay films on faces of peds; about 1 percent gravel; neutral; clear wavy boundary.

Btz—19 to 25 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few very fine roots; common faint clay films on faces of peds; common medium masses of salts; about 1 percent gravel; moderately alkaline; gradual wavy boundary.

Bz—25 to 31 inches; olive brown (2.5Y 4/4) clay loam, light olive brown (2.5Y 5/4) dry; moderate medium subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; common medium masses of salts; about 2 percent gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

C—31 to 60 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; massive; hard, firm, slightly sticky and slightly plastic; few fine nests of gypsum; about 2 percent gravel; strong effervescence; moderately alkaline.

The content of gravel ranges from 1 to 10 percent throughout the profile. The depth to lime ranges from 14 to 35 inches. The depth to salts ranges from 16 to 45 inches. The thickness of the mollic epipedon ranges from 7 to 35 inches.

The A horizon has hue of 10YR, or it is neutral in hue and has value of 3 to 5 dry. The E horizon has value of 3 to 5 (5 to 7 dry) and chroma of 1 or 2. It is silt loam or loam. The Bt horizon has hue of 10YR to 5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. It is clay loam, clay, silty clay, or silty clay loam. Some pedons do not have masses of salts in the lower part of the B horizon. The Bz horizon has hue of 10YR to 5Y, value of 4 or 5 (5 or 6 dry), and chroma of 2 to 4. It is clay loam, silty clay, or clay. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 to 7 dry), and chroma of 2 to 4. It is loam or clay loam.

Clontarf Series

The Clontarf series consists of deep, moderately well drained, moderately rapidly permeable soils on outwash plains. These soils formed in glaciofluvial deposits. Slope ranges from 1 to 6 percent.

Typical pedon of Clontarf fine sandy loam, 1 to 6 percent slopes, 2,280 feet south and 190 feet west of the northeast corner of sec. 4, T. 129 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.
Bw1—8 to 21 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.
Bw2—21 to 28 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; neutral; clear wavy boundary.
2C—28 to 60 inches; olive brown (2.5Y 4/4) fine sand, light olive brown (2.5Y 5/4) dry; common fine distinct dark grayish brown (2.5Y 4/2) mottles; single grain; loose; neutral.

The thickness of the loamy mantle ranges from 20 to 36 inches. The depth to lime ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 16 to 34 inches.

The A horizon has value of 2 or 3. The Bw horizon has chroma of 2 or 3. It is sandy loam or fine sandy loam. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is fine sand, loamy sand, or loamy fine sand.

Coe Series

The Coe series consists of deep, excessively drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 3 to 9 percent.

Typical pedon of Coe loam, in an area of Brantford-Coe loams, 3 to 9 percent slopes; 480 feet west and 150 feet south of the northeast corner of sec. 3, T. 131 N., R. 64 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and common very fine roots; mildly alkaline; abrupt irregular boundary.
C1—6 to 36 inches; dark grayish brown (2.5Y 4/2) extremely gravelly loamy coarse sand, grayish brown (2.5Y 5/2) dry; single grain; loose, nonsticky and nonplastic; about 70 percent shale gravel; moderately alkaline; gradual wavy boundary.
C2—36 to 44 inches; grayish brown (2.5Y 5/2) very gravelly loamy coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; about 50 percent shale gravel; moderately alkaline; gradual wavy boundary.
C3—44 to 60 inches; grayish brown (2.5Y 5/2) gravelly loamy coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; about 25 percent shale gravel; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 12 inches. The depth to sand and gravel ranges from 6 to 14 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). Some pedons have an AC horizon. The C horizon ranges from gravelly coarse sand to extremely gravelly loamy coarse sand. It ranges from 35 to 80 percent shale gravel.

Colvin Series

The Colvin series consists of deep, poorly drained and very poorly drained, moderately slowly permeable, highly calcareous soils on lake plains, till plains, and outwash plains. These soils formed in glaciofluvial deposits and glaciolacustrine sediments. Slope is 0 to 1 percent.

Typical pedon of Colvin silt loam, 1,950 feet west and 380 feet south of the northeast corner of sec. 6, T. 129 N., R. 60 W.

A—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; few fine soft masses of lime; slight effervescence; mildly alkaline; clear wavy boundary.
ABkg—7 to 21 inches; very dark gray (5Y 3/1) silt loam, gray (5Y 5/1) dry; moderate medium subangular blocky structure parting to moderate medium granular; hard, firm, slightly sticky and slightly plastic; many very fine roots; few fine soft masses of lime; strong effervescence; moderately alkaline; clear wavy boundary.
Bkg—21 to 36 inches; olive gray (5Y 5/2) silty clay loam, light gray (5Y 7/1) dry; weak medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; few fine soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.
Cg—36 to 60 inches; olive gray (5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; common medium prominent dark yellowish brown (10YR 4/6) mottles;

massive; hard, friable, sticky and plastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 21 inches. The soil is saline in some pedons.

The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 or 4 dry). Some pedons do not have an ABkg horizon. The Bkg horizon has hue of 2.5Y or 5Y and value of 4 to 6 (6 to 8 dry). The Cg horizon has hue of 5Y or 2.5Y, value of 3 to 6 (5 to 7 dry), and chroma of 1 or 2. It is silt loam or silty clay loam.

Cresbard Series

The Cresbard series consists of deep, moderately well drained, slowly permeable, sodic soils on till plains. These soils formed in glacial till. Slope ranges from 0 to 6 percent.

Typical pedon of Cresbard loam, in an area of Svea-Cresbard loams, 0 to 2 percent slopes; 700 feet west and 150 feet north of the southeast corner of sec. 9, T. 131 N., R. 63 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; neutral; abrupt smooth boundary.

A—6 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

B/E—9 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry (B) and grayish brown (10YR 5/2) dry (E); moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; light gray (10YR 6/1) silt coatings on faces of peds; neutral; clear wavy boundary.

Bt1—12 to 19 inches; very dark grayish brown (2.5Y 3/2) clay loam, dark grayish brown (2.5Y 4/2) dry; strong coarse prismatic structure parting to strong medium and fine angular blocky; extremely hard, very firm, sticky and plastic; few very fine roots; few faint clay films on faces of peds; neutral; clear wavy boundary.

Bt2—19 to 24 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (2.5Y 5/2) dry; strong coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, sticky and plastic; few very fine roots; few faint clay films on faces of peds; about 1 percent gravel; mildly alkaline; clear wavy boundary.

Bkz—24 to 34 inches; light olive brown (2.5Y 5/4) clay loam, light yellowish brown (2.5Y 6/4) dry; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; about 2 percent gravel; few fine masses of salts; common fine irregularly shaped soft masses and common fine irregular filaments and threads of lime; violent effervescence; mildly alkaline; gradual smooth boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) clay loam, light brownish gray (2.5Y 6/2) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; about 2 percent gravel; common fine irregularly shaped soft masses and common fine irregular filaments and threads of lime; violent effervescence; mildly alkaline.

The depth to lime ranges from 15 to 40 inches. The A horizon generally has value of 3 or 4 dry and chroma of 1, but in some pedons it has dry chroma of 2 in the lower part. Some pedons have an E horizon of silt loam or loam 1 to 3 inches thick. The B/E horizon has value of 2 or 3. It is silty clay loam, loam, or clay loam. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3. It is clay or clay loam. Some pedons have a BC, BCk, or BCkz horizon. The C horizon has hue of 2.5Y or 5Y and value of 4 to 6 (5 to 7 dry). It is clay loam or loam. In some pedons it has few or common masses of gypsum or salts.

Divide Series

The Divide series consists of deep, somewhat poorly drained soils on outwash plains. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 0 to 2 percent.

Typical pedon of Divide loam, 0 to 2 percent slopes, 150 feet north and 300 feet west of the southeast corner of sec. 32, T. 130 N., R. 65 W.

A—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; about 3 percent gravel; moderately alkaline; abrupt smooth boundary.

ABk—10 to 13 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; about 3 percent gravel; many medium irregularly shaped

soft masses of lime; slight effervescence; moderately alkaline; abrupt wavy boundary.

Bk1—13 to 22 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; about 10 percent gravel; disseminated lime throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk2—22 to 28 inches; dark gray (5Y 4/1) gravelly loam, gray (5Y 5/1) dry; common fine and medium prominent olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; hard, friable, nonsticky and nonplastic; few very fine roots; about 20 percent gravel; common medium irregular seams of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

2C—28 to 60 inches; olive brown (2.5Y 4/4) very gravelly coarse sand, light olive brown (2.5Y 5/4) dry; single grain; loose, nonsticky and nonplastic; about 40 percent gravel; strong effervescence; moderately alkaline.

The depth to sand and gravel ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 to 5 dry). The Bk horizon has hue of 10YR to 5Y, value of 3 to 6 (5 to 8 dry), and chroma of 1 to 4. The 2C horizon has hue of 10YR to 5Y, value of 4 or 5 (5 to 7 dry), and chroma of 2 to 6.

Eckman Series

The Eckman series consists of deep, well drained, moderately permeable soils on lake plains. These soils formed in glaciolacustrine sediments. Slope ranges from 3 to 6 percent.

Typical pedon of Eckman silt loam, in an area of Eckman-Gardena silt loams, 3 to 6 percent slopes; 135 feet west and 140 feet north of the southeast corner of sec. 22, T. 132 N., R. 60 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine pores; mildly alkaline; abrupt smooth boundary.

Bw1—7 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common pores; mildly alkaline; gradual wavy boundary.

Bw2—12 to 25 inches; dark grayish brown (2.5Y 4/2) silt loam, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common pores; moderately alkaline; clear wavy boundary.

Bk—25 to 35 inches; grayish brown (2.5Y 5/2) very fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C—35 to 60 inches; light olive brown (2.5Y 5/4) very fine sandy loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; slight effervescence; moderately alkaline.

The depth to lime ranges from 10 to 36 inches. The thickness of the mollic epipedon ranges from 7 to 16 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). The Bw horizon has value of 3 to 5 (4 to 6 dry) and chroma of 2 to 4. It is silt loam or very fine sandy loam. The Bk horizon has hue of 2.5Y or 10YR, value of 5 or 6 (6 to 8 dry), and chroma of 2 to 4. It is silt loam or very fine sandy loam. The C horizon has hue of 2.5Y or 10YR, value of 5 or 6 (6 to 8 dry), and chroma of 2 to 4. It is silt loam or very fine sandy loam. In some pedons it is stratified with very fine sand or fine sandy loam.

Edgeley Series

The Edgeley series consists of moderately deep, well drained, moderately permeable soils on till plains. These soils formed in glacial till and material weathered from shale bedrock. Slope ranges from 1 to 6 percent.

Typical pedon of Edgeley loam, 1 to 3 percent slopes, 90 feet west and 625 feet north of the southeast corner of sec. 19, T. 129 N., R. 64 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; neutral; clear smooth boundary.

BA—6 to 15 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots; neutral; clear smooth boundary.

Bw1—15 to 20 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; weak coarse subangular

blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual smooth boundary.

Bw2—20 to 26 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual smooth boundary.

2C—26 to 34 inches; dark brown (10YR 3/3) channery loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; about 20 percent shale channers; neutral; gradual smooth boundary.

2Cr—34 to 60 inches; very dark grayish brown (2.5Y 3/2), soft shale bedrock, grayish brown (2.5Y 5/2) dry; massive; neutral.

The depth to shale bedrock ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 15 inches.

The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry, and chroma of 1 to 3. It is loam, clay loam, channery loam, or channery clay loam. It has 0 to 35 percent shale channers.

Embden Series

The Embden series consists of deep, well drained, moderately rapidly permeable soils on outwash plains. These soils formed in glaciofluvial deposits. Slope ranges from 1 to 6 percent.

Typical pedon of Embden sandy loam, 1 to 6 percent slopes, 620 feet east and 200 feet south of the northwest corner of sec. 6, T. 130 N., R. 61 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; fine medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few fine roots; neutral; abrupt smooth boundary.

Bw1—10 to 20 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark brown (10YR 3/3) dry; weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few fine roots; neutral; clear smooth boundary.

Bw2—20 to 24 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak coarse prismatic structure; soft, very friable, nonsticky and nonplastic; few fine roots; neutral; clear smooth boundary.

Bw3—24 to 39 inches; dark grayish brown (10YR 4/2) sandy loam, brown (10YR 5/3) dry; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and nonplastic; mildly alkaline; clear smooth boundary.

C1—39 to 47 inches; dark grayish brown (2.5Y 4/2) loamy fine sand, grayish brown (2.5Y 5/2) dry; weak coarse prismatic structure; soft, very friable, nonsticky and nonplastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—47 to 60 inches; olive brown (2.5Y 4/4) sandy loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard, very friable, slightly sticky and nonplastic; strong effervescence; moderately alkaline.

The depth to lime ranges from 20 to more than 60 inches. The thickness of the mollic epipedon ranges from 16 to 40 inches.

The A horizon has hue of 10YR, or it is neutral in hue and has value of 2 or 3 (3 or 4 dry) and chroma of 0 or 1. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 to 3. It is fine sandy loam, loam, sandy loam, or very fine sandy loam and generally has thin subhorizons of loamy fine sand. In some pedons, however, it does not have thin strata of loamy fine sand. In some pedons it has few or common faint to distinct mottles in the lower part. Some pedons have a Bk horizon. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is fine sandy loam, sandy loam, loamy fine sand, or very fine sandy loam.

Exline Series

The Exline series consists of deep, somewhat poorly drained, very slowly permeable, sodic soils on lake plains and terraces. These soils formed in glaciolacustrine and alluvial sediments. Slope is 0 to 1 percent.

Typical pedon of Exline silt loam, 1,320 feet east and 50 feet north of the southwest corner of sec. 8, T. 131 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; neutral; abrupt smooth boundary.

Bt—8 to 11 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; few fine and common very fine roots; few faint clay films on faces of peds; mildly alkaline; clear smooth boundary.

Btz—11 to 16 inches; very dark brown (10YR 2/2) silty

clay loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, very firm, sticky and plastic; common very fine roots; few faint clay films on faces of peds; common fine masses and threads of salts; moderately alkaline; clear wavy boundary.

Bkz1—16 to 21 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; about 2 percent gravel; common fine irregular soft masses of salts; lime disseminated throughout and in common fine soft masses; strong effervescence; strongly alkaline; gradual wavy boundary.

Bkz2—21 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; about 2 percent gravel; common medium irregular masses of salts; lime disseminated throughout and in common medium irregular soft masses; strong effervescence; strongly alkaline; gradual wavy boundary.

C1—25 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (2.5Y 7/2) dry; massive; very hard, firm, slightly sticky and slightly plastic; about 2 percent gravel; lime disseminated throughout and in common medium irregular masses; strong effervescence; strongly alkaline; gradual wavy boundary.

C2—31 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam, pale yellow (2.5Y 7/4) dry; massive; very hard, firm, slightly sticky and slightly plastic; lime disseminated throughout and in common medium irregular soft masses; strong effervescence; strongly alkaline.

The depth to lime ranges from 8 to 19 inches. The A horizon has value of 2 or 3 (3 or 4 dry). The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. It is silty clay, clay, silty clay loam, or clay loam. The Bkz horizon has hue of 10YR to 5Y, value of 3 to 5 (4 to 6 dry), and chroma of 1 to 3. It is silty clay, clay, silty clay loam, or clay loam. The C horizon has hue of 2.5Y or 5Y, value of 3 to 7 (5 to 8 dry), and chroma of 2 to 4. It is silt loam or silty clay loam.

Fordville Series

The Fordville series consists of deep, well drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 1 to 3 percent.

Typical pedon of Fordville loam, 1 to 3 percent slopes, 1,090 feet east and 110 feet north of the southwest corner of sec. 15, T. 132 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bw1—8 to 15 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

Bw2—15 to 26 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; neutral; abrupt wavy boundary.

BC—26 to 32 inches; dark grayish brown (2.5Y 4/2) sandy loam, grayish brown (2.5Y 5/2) dry; weak medium subangular blocky structure; mildly alkaline; gradual wavy boundary.

2C—32 to 60 inches; olive brown (2.5Y 4/4) very gravelly sand, light olive brown (2.5Y 5/4) dry; single grain; loose, nonsticky and nonplastic; slight effervescence; about 50 percent gravel; mildly alkaline.

The mollic epipedon ranges from 16 to 30 inches in thickness and commonly includes the Bw horizon. The depth to sand and gravel ranges from 20 to 40 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has value of 2 to 4 (3 to 5 dry) and chroma of 2 to 4. It is loam or clay loam. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 2 to 4. It is loamy sand, gravelly loamy sand, very gravelly loamy sand, or very gravelly sand. It ranges from 5 to 50 percent gravel.

Forman Series

The Forman series consists of deep, well drained, moderately slowly permeable soils on till plains. These soils formed in glacial till. Slope ranges from 1 to 3 percent.

Typical pedon of Forman loam, in an area of Forman-Cavour loams, 1 to 3 percent slopes; 1,300 feet south and 75 feet west of the northeast corner of sec. 25, T. 132 N., R. 65 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark

gray (10YR 3/1) dry; moderate coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine pores; about 2 percent gravel; neutral; abrupt smooth boundary.

Bt1—6 to 10 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky and plastic; common fine and very fine roots; many distinct clay films on faces of peds; black (10YR 2/1) tongues of A material ¼ inch to 1 inch wide; about 2 percent gravel; mildly alkaline; clear wavy boundary.

Bt2—10 to 14 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky and plastic; common fine and very fine roots; many distinct clay films on faces of peds; mildly alkaline; clear smooth boundary.

Bk—14 to 25 inches; olive brown (2.5Y 4/4) loam, light olive brown (2.5Y 5/4) dry; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; few very fine roots; about 2 percent gravel; many medium irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—25 to 60 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; few fine distinct strong brown (7.5YR 5/8) and few fine distinct gray (10YR 5/1) mottles; massive; hard, friable, sticky and plastic; about 2 percent gravel; common medium soft masses of lime; strong effervescence; moderately alkaline.

The content of gravel is as much as 20 percent in the substratum. The thickness of the mollic epipedon ranges from 9 to 16 inches.

The A horizon has value of 3 or 4 dry. The Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 1 to 3. The C horizon is clay loam or loam.

Gardena Series

The Gardena series consists of deep, moderately well drained, moderately permeable soils on lake plains. These soils formed in glaciolacustrine sediments. Slope ranges from 0 to 6 percent.

Typical pedon of Gardena loam, 0 to 3 percent slopes, 180 feet south and 500 feet east of the northwest corner of sec. 25, T. 129 N., R. 60 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and common very fine roots; common fine pores; mildly alkaline; abrupt smooth boundary.

A—7 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common fine pores; mildly alkaline; clear wavy boundary.

Bw—12 to 25 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common fine pores; few medium irregularly shaped soft masses of lime in the lower part; slight effervescence in the lower part; mildly alkaline; gradual wavy boundary.

Bk—25 to 38 inches; light olive brown (2.5Y 5/4) loam, pale yellow (5Y 7/3) dry; moderate coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common fine pores; few masses of gypsum crystals; disseminated lime throughout; strong effervescence; moderately alkaline; clear wavy boundary.

C1—38 to 50 inches; light olive brown (2.5Y 5/4) very fine sandy loam, pale yellow (2.5Y 7/4) dry; few medium distinct yellowish brown (10YR 5/8) and gray (5Y 6/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine pores; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—50 to 54 inches; olive gray (5Y 5/2) very fine sandy loam, pale yellow (5Y 7/3) dry; many medium distinct yellowish brown (10YR 5/6) and gray (5Y 6/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few masses of gypsum crystals; disseminated lime throughout; strong effervescence; moderately alkaline; clear wavy boundary.

C3—54 to 60 inches; light olive brown (2.5Y 5/4) and light gray (5Y 7/2) very fine sandy loam, pale yellow (2.5Y 7/4) and white (5Y 8/2) dry; common medium distinct yellowish brown (10YR 5/6) mottles; soft, very friable, slightly sticky and slightly plastic; few gypsum crystals; disseminated lime throughout; strong effervescence; moderately alkaline.

The depth to lime ranges from about 14 to 40 inches. The thickness of the mollic epipedon ranges from 16 to about 40 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). It is loam or silt loam. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3. The Bk horizon has hue of 10YR to 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. The C horizon has hue of 10YR to 5Y and value of 4 to 6 (5 to 7 dry).

Glyndon Series

The Glyndon series consists of deep, somewhat poorly drained, moderately permeable, highly calcareous soils on lake plains. These soils formed in glaciolacustrine sediments. Slope ranges from 0 to 3 percent.

Typical pedon of Glyndon silt loam, 0 to 3 percent slopes, 1,850 feet east and 160 feet north of the southwest corner of sec. 31, T. 129 N., R. 59 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; mildly alkaline; abrupt smooth boundary.

Bk1—9 to 15 inches; light brownish gray (10YR 6/2) silt loam, light gray (10YR 7/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—15 to 21 inches; light brownish gray (2.5Y 6/2) silt loam, light gray (2.5Y 7/2) dry; common fine distinct olive yellow (2.5Y 6/8) mottles; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C—21 to 60 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, light gray (2.5Y 7/2) dry; many medium prominent olive yellow (2.5Y 6/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The soil is saline in some pedons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bk horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 to 4. It is loamy very fine sand, very fine sandy loam, loam, or silt loam. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 4. It is very fine sand, loamy very fine sand, very fine sandy loam, loam, or silt loam.

Hamar Series

The Hamar series consists of deep, poorly drained, rapidly permeable soils on outwash plains and lake plains. These soils formed in glaciofluvial deposits and eolian materials. Slope ranges from 0 to 3 percent.

Typical pedon of Hamar loamy fine sand, 2,100 feet south and 200 feet east of the northwest corner of sec. 11, T. 129 N., R. 59 W.

A1—0 to 6 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; soft, very friable, slightly sticky and nonplastic; single grain; many fine and very fine roots; neutral; clear wavy boundary.

A2—6 to 12 inches; very dark brown (10YR 2/2) loamy fine sand, very dark gray (10YR 3/1) dry; many fine faint dark brown (10YR 3/3) mottles; weak medium subangular blocky structure parting to single grain; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; neutral; clear wavy boundary.

C1—12 to 24 inches; light brownish gray (2.5Y 6/2) fine sand, light gray (2.5Y 7/2) dry; common fine distinct dark brown (10YR 3/3) and brown (10YR 4/3) mottles; single grain; soft, very friable, nonsticky and nonplastic; few very fine roots; mildly alkaline; gradual wavy boundary.

C2—24 to 34 inches; light brownish gray (2.5Y 6/2) fine sand, light gray (2.5Y 7/2) dry; common medium faint dark yellowish brown (10YR 4/4) mottles; single grain; loose, nonsticky and nonplastic; few very fine roots; mildly alkaline; clear wavy boundary.

Cg1—34 to 48 inches; olive gray (5Y 5/2) fine sand, light gray (5Y 7/2) dry; few medium faint dark grayish brown (10YR 4/2) and few medium prominent black (N 2/0) mottles; single grain; slightly hard, very friable, nonsticky and nonplastic; few fine masses of lime; strong effervescence; mildly alkaline; gradual wavy boundary.

Cg2—48 to 54 inches; olive gray (5Y 5/2) fine sand, light gray (5Y 7/2) dry; common medium prominent dark brown (7.5YR 3/2) mottles; single grain; slightly hard, very friable, nonsticky and nonplastic; disseminated lime throughout; strong effervescence; mildly alkaline; clear wavy boundary.

Cg3—54 to 60 inches; olive gray (5Y 5/2) fine sand, light gray (5Y 7/2) dry; few fine faint light olive brown (2.5Y 5/4) and few fine distinct brown (7.5YR 5/4) mottles; single grain; soft, loose, nonsticky and nonplastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to carbonates ranges from 22 to 50 inches. In some pedons a buried A horizon is below a depth of 30 inches.

The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 to 5 dry). The C horizon has hue of 10YR to 5Y, value of 3 to 6 (5 to 7 dry), and chroma of 1 to 4. It is loamy fine sand, loamy sand, or fine sand.

Hamerly Series

The Hamerly series consists of deep, somewhat poorly drained, moderately slowly permeable, highly calcareous soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Hamerly loam, in an area of Hamerly-Wyard loams, 0 to 3 percent slopes; 180 feet west and 2,200 feet north of the southeast corner of sec. 16, T. 129 N., R. 60 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; about 1 percent gravel; many fine irregularly shaped soft masses of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk—7 to 21 inches; light olive brown (2.5Y 5/4) loam, light brownish gray (2.5Y 6/2) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; about 1 percent gravel; disseminated lime throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C—21 to 60 inches; light yellowish brown (2.5Y 6/4) loam, pale yellow (2.5Y 7/4) dry; common fine distinct olive yellow (2.5Y 6/8), light gray (5Y 6/1), and strong brown (7.5YR 5/8) mottles; weak medium blocky structure; hard, friable, slightly sticky and slightly plastic; about 3 percent gravel; few fine irregularly shaped small masses and threads of lime; strong effervescence; moderately alkaline.

The content of gravel ranges from 1 to 10 percent throughout the profile. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. In some pedons it is noncalcareous. The Bk horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4. It is loam or clay loam. In some pedons the C horizon has few to many masses of gypsum.

Harriet Series

The Harriet series consists of deep, poorly drained, very slowly permeable, saline, sodic soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Harriet loam, 1,400 feet west and 150 feet south of the northeast corner of sec. 26, T. 131 N., R. 64 W.

E—0 to 2 inches; very dark gray (10YR 3/1) loam, gray (10YR 6/1) dry; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt irregular boundary.

Bt—2 to 5 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong coarse columnar structure parting to strong medium subangular blocky; extremely hard, extremely firm, sticky and plastic; few fine and common very fine roots; many distinct clay films on faces of peds; mildly alkaline; gradual wavy boundary.

Btz—5 to 12 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; strong coarse prismatic structure parting to strong medium subangular blocky; extremely hard, very firm, sticky and plastic; common very fine roots; many distinct clay films on faces of peds; common fine irregular filaments and threads of salts; slight effervescence; moderately alkaline; gradual wavy boundary.

Btzg—12 to 21 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, slightly sticky and plastic; few very fine roots; common distinct clay films on faces of peds; common fine round soft masses of salts; strong effervescence; strongly alkaline; gradual wavy boundary.

Bzg—21 to 29 inches; olive gray (5Y 5/2) clay, light gray (5Y 7/2) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and plastic; common medium irregularly shaped soft masses of salts; strong effervescence; strongly alkaline; gradual wavy boundary.

Cg1—29 to 39 inches; olive (5Y 5/3) clay, pale olive (5Y 6/3) dry; few fine prominent dark yellowish brown (10YR 3/6) mottles; massive; extremely hard, firm, sticky and plastic; few fine and medium irregularly shaped soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg2—39 to 60 inches; olive gray (5Y 5/2) clay, light gray (5Y 7/2) dry; common medium prominent dark yellowish brown (10YR 4/6) mottles; few medium irregularly shaped soft masses of lime; strong effervescence; moderately alkaline.

The depth to lime and salts ranges from 4 to 11 inches. Some pedons have an A horizon 1 to 2 inches thick.

The E horizon has hue of 10YR or 2.5Y and value of 3 or 4 (5 or 6 dry). The Bt horizon has value of 3 to 5 dry and chroma of 1 to 4. It is clay loam, silty clay loam, silty clay, or clay. The Bzg horizon has hue of 10YR to 5Y, value of 3 to 7 (5 to 8 dry), and chroma of 2 to 4. It is clay loam or clay. The Cg horizon has hue of 2.5Y or 5Y and value of 3 to 5 (5 to 7 dry). It ranges from very fine sandy loam to clay.

Hecla Series

The Hecla series consists of deep, moderately well drained, rapidly permeable soils on lake plains and outwash plains. These soils formed in glaciolacustrine sediments, glaciofluvial deposits, and eolian materials. Slope ranges from 0 to 3 percent.

Typical pedon of Hecla loamy fine sand, 0 to 3 percent slopes, 1,230 feet north and 320 feet east of the southwest corner of sec. 26, T. 130 N., R. 59 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; abrupt smooth boundary.

A—9 to 20 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine and very fine roots; neutral; clear wavy boundary.

AC—20 to 32 inches; very dark grayish brown (10YR 3/2) fine sand, grayish brown (10YR 5/2) dry; common medium distinct brownish yellow (10YR 6/6) mottles; weak fine subangular blocky structure; loose, nonsticky and nonplastic; few very fine roots; neutral; abrupt wavy boundary.

Ab—32 to 38 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; few fine faint yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; mildly alkaline; abrupt wavy boundary.

C1—38 to 42 inches; grayish brown (2.5Y 5/2) fine sand, light gray (2.5Y 7/2) dry; few fine faint light yellowish brown (2.5Y 6/4) mottles; single grain; loose, nonsticky and nonplastic; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose, nonsticky and nonplastic; disseminated lime throughout; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. Some pedons do not have a buried A horizon. The depth to lime ranges from 20 to 60 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). The C horizon has hue of 10YR to 5Y, value of 3 to 5 (4 to 7 dry), and chroma of 2 to 4.

Kratka Series

The Kratka series consists of deep, poorly drained soils on till plains. These soils formed in glaciolacustrine sediments and glacial till. Permeability is moderately rapid in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 2 percent.

Typical pedon of Kratka fine sandy loam, in an area of Kratka-Letcher fine sandy loams, 0 to 2 percent slopes; 1,890 feet north and 580 feet east of the southwest corner of sec. 29, T. 129 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; slightly acid; abrupt smooth boundary.

Bw1—8 to 19 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; loose, nonsticky and nonplastic; common very fine roots; neutral; clear wavy boundary.

Bw2—19 to 34 inches; dark grayish brown (2.5Y 4/2) fine sand, light brownish gray (2.5Y 6/2) dry; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; loose, nonsticky and nonplastic; few very fine roots; mildly alkaline; abrupt wavy boundary.

2Ab—34 to 37 inches; dark gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; mildly alkaline; clear wavy boundary.

2Cg1—37 to 54 inches; grayish brown (2.5Y 5/2) loam, light olive brown (2.5Y 5/4) dry; common medium prominent yellowish brown (10YR 5/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; about 2 percent gravel; many fine irregularly shaped filaments of lime; slight effervescence; mildly alkaline; gradual wavy boundary.

2Cg2—54 to 60 inches; light brownish gray (2.5Y 6/2)

fine sandy loam, light gray (2.5Y 7/2) dry; many large prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, nonsticky and nonplastic; few fine irregularly shaped filaments of lime; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 8 to 18 inches. The depth to lime ranges from 20 to 45 inches.

The A horizon has hue of 10YR or 2.5Y, or it is neutral in hue and has value of 2 or 3 and chroma of 0 to 2. The Bw horizon has value of 4 to 6 and chroma of 1 or 2. It is loamy fine sand, fine sand, or loamy sand. The 2Cg horizon has hue of 10YR to 5Y and chroma of 1 to 3. It is loam, clay loam, sandy loam, or fine sandy loam.

Lamoure Series

The Lamoure series consists of deep, poorly drained, moderately slowly permeable soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Lamoure silt loam, 2,260 feet west and 630 feet south of the northeast corner of sec. 34, T. 132 N., R. 60 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; slight effervescence; moderately alkaline; abrupt smooth boundary.

A1—8 to 15 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; few fine irregularly shaped soft filaments of lime; strong effervescence; mildly alkaline; clear wavy boundary.

A2—15 to 31 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; common fine faint brown (10YR 4/3) mottles; weak medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky and plastic; common very fine and fine roots; common medium irregularly shaped soft masses of lime; strong effervescence; mildly alkaline; clear wavy boundary.

Ab—31 to 36 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; lime disseminated throughout and in few fine irregularly shaped soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg1—36 to 44 inches; olive gray (5Y 4/2) silty clay loam, olive gray (5Y 5/2) dry; common fine distinct light yellowish brown (2.5Y 6/4) mottles; weak medium subangular blocky structure; hard, firm, sticky and plastic; lime disseminated throughout and in many common medium irregularly shaped soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg2—44 to 60 inches; olive gray (5Y 4/2) silty clay loam, olive gray (5Y 5/2) dry; common fine distinct light yellowish brown (2.5Y 6/4) mottles; firm, sticky and plastic; common medium rounded nests of gypsum; strong effervescence; moderately alkaline.

The depth to lime ranges from 0 to 10 inches. The thickness of the mollic epipedon ranges from 24 to 42 inches. The A horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 2 or 3 (3 to 5 dry) and chroma of 0 or 1.

La Prairie Series

The La Prairie series consists of deep, moderately well drained, moderately permeable soils on terraces, flood plains, and alluvial fans. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of La Prairie loam, 2,600 feet north and 130 feet east of the southwest corner of sec. 16, T. 131 N., R. 63 W.

A1—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; mildly alkaline; clear wavy boundary.

A2—6 to 18 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; mildly alkaline; clear wavy boundary.

Bw—18 to 22 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and very fine roots; mildly alkaline; clear wavy boundary.

Ab—22 to 29 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and very fine roots; mildly alkaline; clear wavy boundary.

C1—29 to 44 inches; dark grayish brown (2.5Y 4/2)

loam, grayish brown (2.5Y 5/2) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; lime disseminated throughout and in few fine irregularly shaped small masses; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—44 to 60 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; common fine irregular threads of lime; violent effervescence; moderately alkaline.

The depth to lime ranges from 0 to 40 inches. The thickness of the mollic epipedon ranges from 16 to more than 40 inches.

The A horizon has hue of 10YR, or it is neutral in hue and has value of 2 or 3 (3 or 4 dry) and chroma of 0 or 1. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3. It is loam, silt loam, or silty clay loam. The C horizon has hue of 10YR to 5Y, value of 3 to 5 (4 to 7 dry), and chroma of 1 to 3. In some pedons it has few to many faint to distinct mottles.

Lehr Series

The Lehr series consists of deep, somewhat excessively drained soils on outwash plains. These soils formed in glaciofluvial deposits. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slope ranges from 1 to 6 percent.

Typical pedon of Lehr loam, in an area of Lehr-Wabek loams, 1 to 6 percent slopes; 1,050 feet east and 200 feet north of the southwest corner of sec. 31, T. 130 N., R. 66 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt smooth boundary.

Bw—9 to 14 inches; dark brown (10YR 3/3) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt wavy boundary.

Bk—14 to 17 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; slightly hard, very friable, sticky and plastic; common fine and very fine roots; disseminated lime throughout; mildly alkaline; abrupt wavy boundary.

2C—17 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly coarse sand, grayish brown (2.5Y 5/2) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; about 20 percent gravel; mildly alkaline.

The depth to sand and gravel ranges from 14 to 20 inches. The A horizon has value of 3 to 5 dry. The B horizon has value of 4 to 6 dry. It is loam or clay loam. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (5 to 8 dry), and chroma of 2 to 4.

Letcher Series

The Letcher series consists of deep, somewhat poorly drained, sodic soils on lake plains, till plains, and outwash plains. These soils formed in glaciofluvial deposits, glacial till, eolian materials, and glaciolacustrine sediments. Permeability is slow in the upper part of the profile and moderately rapid in the lower part. Slope ranges from 0 to 3 percent.

Typical pedon of Letcher fine sandy loam, in an area of Kratka-Letcher fine sandy loams, 0 to 2 percent slopes; 2,290 feet west and 260 feet north of the southeast corner of sec. 32, T. 129 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak moderate subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; abrupt smooth boundary.

E—8 to 9 inches; very dark gray (10YR 3/1) sandy loam, gray (10YR 5/1) dry; common fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; clear wavy boundary.

Bt—9 to 18 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; many fine faint dark yellowish brown (10YR 3/4) mottles; strong coarse prismatic structure parting to strong coarse subangular blocky; very hard, friable, nonsticky and nonplastic; few fine and very fine roots; few faint clay films on faces of peds; mildly alkaline; clear wavy boundary.

Btkz—18 to 22 inches; dark grayish brown (2.5Y 4/2) sandy loam, grayish brown (2.5Y 5/2) dry; few fine prominent dark yellowish brown (10YR 3/4) mottles; strong coarse prismatic structure parting to strong coarse subangular blocky; very hard, friable, nonsticky and nonplastic; few very fine roots; few faint clay films on faces of peds; common medium rounded soft masses of salts; common medium

rounded soft masses of lime; strong effervescence; mildly alkaline; abrupt wavy boundary.

Bk1—22 to 31 inches; grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; massive; hard, friable, slightly sticky and slightly plastic; few fine roots; disseminated lime throughout; violent effervescence; mildly alkaline; clear wavy boundary.

Bk2—31 to 42 inches; olive gray (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; massive; hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; violent effervescence; mildly alkaline; abrupt wavy boundary.

2C—42 to 60 inches; olive brown (2.5Y 4/4) fine sandy loam, light yellowish brown (2.5Y 6/4) dry; common fine prominent dark yellowish brown (10YR 4/6) and gray (10YR 5/1) mottles; massive; soft, very friable, nonsticky and nonplastic; strong effervescence; mildly alkaline.

The depth to lime ranges from 10 to 25 inches. The A horizon has value of 2 or 3 (3 to 5 dry). The E horizon has hue of 10YR or 2.5Y, value of 3 to 5 (5 to 7 dry), and chroma of 1 or 2. It is loamy fine sand, fine sandy loam, or sandy loam. The Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3. It is sandy loam, fine sandy loam, or loam. Some pedons do not have a Bk horizon. The C horizon has hue of 10YR to 5Y, value of 3 to 6 (5 to 7 dry), and chroma of 1 to 4. It is sandy loam, fine sandy loam, loam, or loamy fine sand.

Ludden Series

The Ludden series consists of deep, poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Ludden clay, 50 feet north and 50 feet east of the southwest corner of sec. 32, T. 131 N., R. 59 W.

Ap—0 to 5 inches; black (10YR 2/1) clay, dark gray (N 4/0) dry; moderate medium subangular blocky structure parting to moderate very fine angular blocky; extremely hard, firm, sticky and very plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—5 to 14 inches; black (10YR 2/1) clay, dark gray (N 4/0) dry; moderate medium angular blocky structure; extremely hard, firm, sticky and very plastic; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw—14 to 30 inches; black (10YR 2/1) clay, dark gray (N 4/0) dry; moderate medium angular blocky structure; extremely hard, firm, sticky and very plastic; common gypsum crystals in the lower part; common medium masses of lime; slight effervescence; moderately alkaline; gradual wavy boundary.

Cg1—30 to 46 inches; dark gray (5Y 4/1) clay, dark gray (N 4/0) dry; massive; extremely hard, firm, sticky and very plastic; many medium masses of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—46 to 60 inches; very dark gray (5Y 3/1) clay, gray (5Y 5/1) dry; massive; extremely hard, firm, sticky and very plastic; common snail shells; common large masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 24 to 48 inches. The soil is saline in some pedons. Some pedons have an O horizon, which is 1 to 3 inches thick.

The A horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 2 or 3 (3 to 5 dry) and chroma of 0 or 1. The Bw horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 2 to 4 (4 to 6 dry) and chroma of 0 to 2. It is clay, silty clay, or silty clay loam. Some pedons have a Bzg horizon. The Cg horizon has hue of 2.5Y or 5Y, or it is neutral in hue and has value of 2 to 4 (3 to 5 dry) and chroma of 0 to 2.

Maddock Series

The Maddock series consists of deep, well drained, rapidly permeable soils on lake plains. These soils formed in eolian materials and glaciolacustrine sediments. Slope ranges from 1 to 3 percent.

Typical pedon of Maddock fine sandy loam, 1 to 3 percent slopes, 650 feet west and 600 feet south of the northeast corner of sec. 22, T. 130 N., R. 63 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; loose, nonsticky and nonplastic; common fine and very fine roots; neutral; gradual wavy boundary.

Bw1—9 to 13 inches; dark yellowish brown (10YR 3/4) loamy fine sand, dark yellowish brown (10YR 4/4) dry; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; clear wavy boundary.

Bw2—13 to 21 inches; dark yellowish brown (10YR 4/4) fine sand, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure parting to single grain; loose, nonsticky and nonplastic; few very fine roots; mildly alkaline; abrupt wavy boundary.

Bw3—21 to 27 inches; dark yellowish brown (10YR 4/4)

fine sand, light yellowish brown (10YR 6/4) dry; weak fine angular blocky structure parting to single grain; loose, nonsticky and nonplastic; moderately alkaline; gradual wavy boundary.

C1—27 to 38 inches; olive brown (2.5Y 4/4) sand, light yellowish brown (2.5Y 6/4) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; mildly alkaline; gradual wavy boundary.

C2—38 to 60 inches; light olive brown (2.5Y 5/4) sand, pale yellow (2.5Y 7/4) dry; single grain; loose, nonsticky and nonplastic; disseminated lime throughout; strong effervescence; moderately alkaline.

The depth to lime is 10 inches or more. The thickness of the mollic epipedon ranges from 10 to 16 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). Some pedons have an AC horizon. The Bw horizon has value of 2 to 5 and chroma of 2 to 4. It is fine sand, loamy fine sand, or loamy sand. The C horizon has hue of 2.5Y or 10YR, value of 3 to 6 (4 to 7 dry), and chroma of 2 to 4.

Makoti Series

The Makoti series consists of deep, moderately well drained, moderately slowly permeable soils on lake plains. These soils formed in glaciolacustrine sediments. Slope ranges from 1 to 6 percent.

Typical pedon of Makoti silt loam, in an area of Makoti-Sakakawea silt loams, 1 to 3 percent slopes; 2,390 feet north and 440 feet east of the southwest corner of sec. 22, T. 130 N., R. 66 W.

Ap—0 to 5 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; hard, very friable, sticky and plastic; neutral; abrupt smooth boundary.

A—5 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate coarse subangular blocky structure; hard, very friable, sticky and plastic; neutral; clear wavy boundary.

Bw1—9 to 15 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; neutral; gradual wavy boundary.

Bw2—15 to 19 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few fine irregularly shaped soft masses of lime; slight effervescence; mildly alkaline; gradual wavy boundary.

Bk—19 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable, sticky and plastic; lime disseminated throughout and in few medium irregularly shaped soft masses; violent effervescence; mildly alkaline; clear wavy boundary.

C—34 to 60 inches; grayish brown (2.5Y 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; common fine distinct light olive brown (2.5Y 5/4) mottles; massive; hard, friable, slightly sticky and slightly plastic; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 16 to 24 inches. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. The Bw horizon has hue of 2.5Y or 10YR, value of 3 to 5 dry, and chroma of 1 to 3. The Bk horizon has value of 4 to 6 (5 to 7 dry) and chroma of 2 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 to 7 dry), and chroma of 2 to 6. In some pedons the C horizon has thin strata ranging from very fine sandy loam to silty clay loam.

Max Series

The Max series consists of deep, well drained, moderately slowly permeable soils on moraines. These soils formed in glacial till. Slope ranges from 15 to 45 percent.

Typical pedon of Max loam, in an area of Zahl-Max loams, 15 to 45 percent slopes; 570 feet east and 310 feet north of the southwest corner of sec. 27, T. 132 N., R. 65 W.

A—0 to 5 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; about 1 percent gravel; mildly alkaline; clear wavy boundary.

Bw1—5 to 12 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; strong medium prismatic structure parting to strong medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common pores; about 1 percent gravel; mildly alkaline; clear wavy boundary.

Bw2—12 to 17 inches; brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; moderate medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; about 1 percent gravel; mildly alkaline; abrupt wavy boundary.

Bk—17 to 32 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable, slightly sticky and slightly plastic; about 2 percent gravel; common fine irregularly shaped small masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; few fine prominent yellowish brown (10YR 5/8) mottles; massive; hard, friable, slightly sticky and slightly plastic; about 2 percent gravel; lime disseminated throughout and in few small soft masses; strong effervescence; mildly alkaline.

The content of gravel ranges from 1 to 8 percent throughout the profile. The thickness of the mollic epipedon ranges from 7 to 16 inches.

The A horizon has value of 2 or 3 (4 or 5 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry, and chroma of 2 to 4. The Bk horizon has value of 4 to 6 (5 to 7 dry) and chroma of 2 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 to 7 dry), and chroma of 2 to 4. It is loam or clay loam.

Miranda Series

The Miranda series consists of deep, moderately well drained, very slowly permeable, saline, sodic soils on till plains. These soils formed in glacial till. Slope ranges from 1 to 3 percent.

Typical pedon of Miranda loam, in an area of Miranda-Cavour loams, 1 to 3 percent slopes; 180 feet south and 100 feet west of the northeast corner of sec. 7, T. 131 N., R. 64 W.

Ap—0 to 4 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and many very fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

Bt—4 to 8 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; strong coarse prismatic structure parting to strong medium subangular blocky; extremely hard, extremely firm, sticky and plastic; few fine and common very fine roots; common faint clay films on faces of peds; about 1 percent gravel; mildly alkaline; clear wavy boundary.

Btz—8 to 15 inches; very dark grayish brown (2.5Y 3/2) clay loam, dark grayish brown (2.5Y 4/2) dry; strong coarse prismatic structure parting to strong medium subangular blocky; extremely hard, very firm, sticky and plastic; common very fine roots; few faint clay films on faces of peds; about 1 percent gravel; common fine irregular filaments and threads of salts; moderately alkaline; clear wavy boundary.

Bkz—15 to 27 inches; light olive brown (2.5Y 5/4) clay loam, light yellowish brown (2.5Y 6/4) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few very fine roots; about 2 percent gravel; common medium irregularly shaped soft masses of salts; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C—27 to 60 inches; olive (5Y 5/3) clay loam, pale olive (5Y 6/3) dry; massive; hard, firm, sticky and plastic; about 2 percent gravel; common medium irregularly shaped masses of salts; lime disseminated throughout and in common medium irregularly shaped soft masses; strong effervescence; strongly alkaline.

The depth to lime ranges from 8 to 25 inches. The depth to gypsum or salts ranges from 6 to 16 inches.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. Some pedons have an E horizon, which is 1 to 5 inches thick. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 6 dry), and chroma of 1 to 4. It is clay loam or loam. The Bkz horizon has hue of 10YR to 5Y, value of 3 to 6 (3 to 7 dry), and chroma of 2 to 4. The C horizon has hue of 10YR to 5Y, value of 3 to 7 (4 to 8 dry), and chroma of 1 to 4. It is clay loam or loam.

Overly Series

The Overly series consists of deep, moderately well drained, moderately slowly permeable soils on lake plains. These soils formed in glaciolacustrine sediments. Slope is 0 to 1 percent.

Typical pedon of Overly silt loam, 200 feet north and 300 feet east of the southwest corner of sec. 18, T. 130 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak coarse prismatic structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots;

neutral; clear wavy boundary.

Bw—13 to 19 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate fine angular blocky; hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

Bk1—19 to 30 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—30 to 42 inches; light brownish gray (2.5Y 6/2) silt loam, light gray (2.5Y 7/2) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline; clear wavy boundary.

C—42 to 60 inches; olive yellow (2.5Y 6/6) silt loam, pale yellow (2.5Y 7/4) dry; many fine distinct gray (5Y 6/1) mottles; massive; hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 30 inches. The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 2.5Y or 10YR, value of 3 to 5 (3 to 7 dry), and chroma of 1 to 3. The Bk horizon has hue of 2.5Y or 10YR, value of 4 to 6 (6 or 7 dry), and chroma of 2 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (6 or 7 dry), and chroma of 1 to 4. It is silty clay loam, silt loam, or silty clay.

Parnell Series

The Parnell series consists of deep, very poorly drained, slowly permeable soils on till plains and moraines. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Parnell silty clay loam, 160 feet north and 2,000 feet west of the southeast corner of sec. 5, T. 130 N., R. 60 W.

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and plastic; common very fine and fine roots; neutral; abrupt smooth boundary.

A—6 to 11 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; few fine distinct dark brown (7.5YR 3/4) mottles; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; slightly acid; clear wavy boundary.

Bt—11 to 26 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong coarse prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; few very fine and fine roots; many faint clay films on faces of peds; slightly acid; gradual wavy boundary.

Btg—26 to 41 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; strong coarse prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; common faint clay films on faces of peds; neutral; gradual wavy boundary.

BCg—41 to 60 inches; very dark gray (5Y 3/1) clay, dark gray (5Y 4/1) dry; common fine prominent dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very hard, firm, sticky and plastic; few faint clay films on faces of peds; neutral.

The depth to lime ranges from 35 to more than 60 inches. Some pedons have an O horizon, which ranges from 1 to 6 inches in thickness. The thickness of the mollic epipedon ranges from 24 to more than 60 inches.

The A horizon has hue of 10YR to 5Y, or it is neutral in hue. The Bt horizon has value of 2 to 4 and chroma of 1 or 2. It is silty clay, silty clay loam, clay loam, or clay. Some pedons have a Cg horizon.

Renshaw Series

The Renshaw series consists of deep, somewhat excessively drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 0 to 6 percent.

Typical pedon of Renshaw loam, in an area of Renshaw-Sioux loams, 1 to 6 percent slopes; 800 feet west and 2,600 feet south of the northeast corner of sec. 34, T. 132 N., R. 65 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; neutral; clear smooth boundary.

Bw—8 to 15 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and nonplastic; common fine roots;

about 2 percent gravel; neutral; clear smooth boundary.

2C—15 to 60 inches; very dark grayish brown (10YR 3/2) gravelly loamy sand, grayish brown (10YR 5/2) dry; single grain; few fine roots; about 25 percent gravel; mildly alkaline.

The thickness of the solum and the depth to sand and gravel range from 14 to 20 inches. The thickness of the mollic epipedon ranges from 10 to 16 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has value of 3 or 4 (3 to 5 dry) and chroma of 1 to 4. It is loam, sandy clay loam, or gravelly loam. It ranges from 0 to 30 percent gravel. The 2C horizon is gravelly loamy sand, very gravelly loamy sand, gravelly sand, very gravelly sand, gravelly coarse sand, very gravelly coarse sand, or coarse sand. In some pedons the upper part of the C horizon has lime occurring as coatings on the undersides of pebbles.

Rosewood Series

The Rosewood series consists of deep, poorly drained and very poorly drained, moderately rapidly permeable, highly calcareous soils on lake plains and outwash plains. These soils formed in glaciolacustrine sediments and glaciofluvial deposits. Slope is 0 to 1 percent.

Typical pedon of Rosewood fine sandy loam, 2,430 feet west and 840 feet north of the southeast corner of sec. 10, T. 129 N., R. 59 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; many fine and very fine roots; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bk—9 to 17 inches; dark gray (2.5Y 4/0) fine sandy loam, gray (2.5Y 6/0) dry; few fine distinct light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; friable; common very fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

C1—17 to 26 inches; grayish brown (2.5Y 5/2) loamy fine sand, light brownish gray (2.5Y 6/2) dry; common medium distinct olive yellow (2.5Y 6/6) mottles; single grain; loose; few very fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

C2—26 to 60 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; many medium prominent light olive brown (2.5Y 5/6) mottles; single grain; loose; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 24 inches. Some pedons have a buried A horizon.

The A horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 2 or 3 and chroma of 0 or 1. The Bk horizon has hue of 2.5Y or 5Y, or it is neutral in hue and has value of 3 to 7 and chroma of 0 to 2. It is sandy loam, fine sandy loam, loamy sand, or loamy fine sand. The C horizon has hue of 2.5Y or 5Y and value of 4 to 6. It is loamy fine sand, sand, or fine sand.

Ruso Series

The Ruso series consists of deep, well drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slope ranges from 1 to 6 percent.

Typical pedon of Ruso sandy loam, 1 to 6 percent slopes, 1,050 feet south and 300 feet east of the northwest corner of sec. 32, T. 131 N., R. 66 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt smooth boundary.

Bw1—8 to 17 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; mildly alkaline; gradual smooth boundary.

Bw2—17 to 26 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; mildly alkaline; clear wavy boundary.

2C—26 to 60 inches; olive brown (2.5Y 4/4) sand, light olive brown (2.5Y 5/4) dry; single grain; loose, nonsticky and nonplastic; about 5 percent gravel; slight effervescence; mildly alkaline.

The depth to lime ranges from 20 to 40 inches. The depth to sand and gravel ranges from 25 to 40 inches. The thickness of the mollic epipedon ranges from 16 to 32 inches.

The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 2 or 3. It is coarse sandy loam, fine sandy loam, or sandy loam.

Ryan Series

The Ryan series consists of deep, poorly drained, very slowly permeable soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Ryan silty clay, in an area of Ryan-Ludden complex; 1,810 feet south and 1,735 feet west of the northeast corner of sec. 36, T. 132 N., R. 60 W.

E—0 to 2 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak thin platy and angular blocky structure; very hard, firm, sticky and plastic; many fine roots; moderately alkaline; abrupt smooth boundary.

Bt1—2 to 4 inches; black (10YR 2/1) silty clay, dark gray (5Y 4/1) dry; strong medium and coarse columnar structure parting to strong fine angular blocky; top of columns coated with gray (5Y 5/1) silt coatings; very hard, firm, very sticky and very plastic; common fine roots; many faint clay films on faces of peds; strongly alkaline; clear smooth boundary.

Bt2—4 to 8 inches; black (10YR 2/1) silty clay, dark gray (5Y 4/1) dry; moderate medium and coarse prismatic structure parting to strong fine angular blocky; very hard, firm, very sticky and very plastic; many fine roots; many faint clay films on faces of peds; slight effervescence; strongly alkaline; clear wavy boundary.

Bg1—8 to 22 inches; black (10YR 2/1) silty clay, dark gray (N 4/0) dry; very weak coarse prismatic structure parting to moderate fine subangular blocky; very hard, firm, very sticky and very plastic; common fine roots; few masses of lime; common fine salt crystals; strong effervescence; strongly alkaline; gradual wavy boundary.

Bg2—22 to 36 inches; black (10YR 2/1) silty clay, dark gray (N 4/0) dry; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky and very plastic; few masses of lime; common fine salt crystals; strong effervescence; strongly alkaline; gradual wavy boundary.

Cg—36 to 60 inches; very dark gray (5Y 3/1) silty clay, gray (N 5/0) dry; massive; very hard, firm, very sticky and very plastic; common fine gypsum crystals; few fine masses of lime; strong effervescence; strongly alkaline.

The depth to lime typically ranges from about 4 to 10 inches, but some pedons have carbonates at the surface. The thickness of the mollic epipedon ranges from 20 to more than 48 inches.

The E horizon is ¼ inch to 2 inches thick. The Bt horizon has hue of 10YR to 5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is clay or silty clay. Some pedons have a Btz, Bk, or Bkz horizon. The Bg and Cg horizons have hue of 10YR to 5Y, or they are neutral in hue and have value of 2 to 4 (4 to 6 dry) and chroma of 0 to 3. They are silty clay, clay, or silty clay loam.

Sakakawea Series

The Sakakawea series consists of deep, well drained, moderately permeable soils on lake plains. These soils formed in glaciolacustrine sediments. Slopes range from 1 to 6 percent.

Typical pedon of Sakakawea silt loam, in an area of Makoti-Sakakawea silt loams, 3 to 6 percent slopes; 1,500 feet south and 180 feet west of the northeast corner of sec. 21, T. 130 N., R. 66 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bk1—7 to 15 inches; grayish brown (2.5Y 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—15 to 26 inches; grayish brown (2.5Y 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

C1—26 to 34 inches; light brownish gray (2.5Y 6/2) silt loam, light gray (2.5Y 7/2) dry; common distinct light yellowish brown (2.5Y 6/4) and gray (10YR 5/1) relict mottles; massive; hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—34 to 60 inches; light brownish gray (2.5Y 6/2) silt loam, light gray (2.5Y 7/2) dry; many fine prominent yellowish brown (10YR 5/6) and gray (10YR 5/1) relict mottles; massive; hard, very friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 10 inches. The A horizon has value of 2 or 3 (3 to 5 dry) and chroma of 1 or 2. The Bk horizon has value of 4 to 6 (6 to 8 dry) and chroma of 2 to 4. The C horizon has value of 4 to 6 (6 to 8 dry) and chroma of 2 to 4. It is silt loam or silty clay loam.

Serden Series

The Serden series consists of deep, excessively drained, rapidly permeable soils on lake plains and outwash plains. These soils formed in eolian materials. Slope ranges from 1 to 6 percent.

Typical pedon of Serden fine sand, in an area of Serden-Hamar complex, 0 to 6 percent slopes; 2,150 feet north and 820 feet east of the southwest corner of sec. 11, T. 129 N., R. 59 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) fine sand, dark grayish brown (10YR 4/2) dry; single grain; loose; many fine roots; neutral; clear smooth boundary.

AC—4 to 9 inches; very dark grayish brown (10YR 3/2) fine sand, grayish brown (10YR 5/2) dry; single grain; loose; common fine roots; neutral; clear smooth boundary.

C—9 to 60 inches; dark brown (10YR 4/3) fine sand, brown (10YR 5/3) dry; single grain; loose; few fine roots; neutral.

The depth to carbonates ranges from 36 to more than 60 inches. Some pedons have a buried A horizon.

The A horizon has value of 2 to 4 (3 to 6 dry) and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6 (4 to 7 dry), and chroma of 2 to 4. It is fine sand or sand.

Sinai Series

The Sinai series consists of deep, moderately well drained, slowly permeable soils on lake plains. These soils formed in glaciolacustrine sediments. Slopes range from 0 to 2 percent.

Typical pedon of Sinai silty clay, 0 to 2 percent slopes, 2,570 feet north and 200 feet west of the southeast corner of sec. 27, T. 132 N., R. 65 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine granular structure; very hard, friable, sticky and plastic; few medium and common fine roots; mildly alkaline; abrupt smooth boundary.

Bw—9 to 25 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; few fine roots; tongues filled with A material extending throughout; mildly alkaline; clear smooth boundary.

Bk—25 to 49 inches; olive gray (5Y 4/2) silty clay, olive gray (5Y 5/2) dry; weak medium prismatic structure parting to moderate medium blocky; very hard, firm, sticky and plastic; few very fine roots; faces of peds have a shiny, waxy sheen when moist; tongues filled with A material extending throughout; many large irregularly shaped soft masses of lime; strong effervescence; moderately alkaline; clear smooth boundary.

C—49 to 60 inches; olive (5Y 4/3) clay loam, olive (5Y 5/3) dry; massive; very hard, friable, sticky and plastic; about 3 percent gravel; few medium irregularly shaped soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 25 inches. The A horizon has value of 2 or 3 (3 or 4 dry) and chroma of 1 or 2. The Bw horizon has hue of 10YR to 5Y, value of 2 to 4 (3 or 4 dry), and chroma of 1 to 3. It is silty clay, clay, or silty clay loam. The Bk and C horizons have hue of 10YR to 5Y, value of 3 to 6 (4 to 7 dry), and chroma of 1 to 6. The C horizon is silty clay loam, silt loam, clay loam, or silty clay. In some pedons it has thin strata of silt loam.

Sioux Series

The Sioux series consists of deep, excessively drained, very rapidly permeable soils on outwash plains, eskers, and terraces. These soils formed in glaciofluvial deposits. Slope ranges from 1 to 15 percent.

Typical pedon of Sioux loam, 1 to 15 percent slopes, 2,200 feet west and 2,600 feet north of the southeast corner of sec. 34, T. 132 N., R. 65 W.

A—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; about 2 percent gravel; mildly alkaline; clear smooth boundary.

C—8 to 60 inches; dark grayish brown (10YR 4/2) very gravelly coarse sand, light brownish gray (10YR 6/2) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; about 40 percent gravel; lime accumulations on undersides of pebbles; slight effervescence; mildly alkaline.

The depth to sand and gravel ranges from 6 to 14 inches. The depth to lime typically ranges from 3 to 8 inches, but some pedons are calcareous at the surface. The thickness of the mollic epipedon ranges from 7 to 14 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). Some pedons have an AC horizon. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It ranges from very gravelly loamy sand to extremely gravelly coarse sand.

Southam Series

The Southam series consists of deep, very poorly drained, slowly permeable soils on till plains, moraines, and lake plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Southam silt loam, 300 feet west and 100 feet north of the southeast corner of sec. 2, T. 130 N., R. 62 W.

Oe—6 inches to 0; partially decomposed leaves, stems, and roots.

A—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; many medium and fine roots; few fine fragments of snail shells; mildly alkaline; gradual wavy boundary.

Ag1—8 to 17 inches; black (5Y 2/1) silty clay loam, very dark gray (5Y 3/1) dry; weak fine subangular blocky structure; hard, firm, sticky and plastic; few fine and very fine roots; few fine fragments of snail shells; slight effervescence; mildly alkaline; gradual wavy boundary.

Ag2—17 to 24 inches; very dark gray (5Y 3/1) clay loam, dark gray (5Y 4/1) dry; few fine prominent light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; very hard, very firm, very sticky and very plastic; few fine roots; common fine fragments of snail shells; slight effervescence; mildly alkaline; gradual wavy boundary.

Cg1—24 to 28 inches; olive gray (5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; common medium prominent light olive brown (2.5Y 5/6) mottles; massive; hard, firm, sticky and plastic; few medium rounded masses of gypsum; strong effervescence; mildly alkaline; gradual wavy boundary.

Cg2—28 to 42 inches; olive gray (5Y 5/2) clay, light olive gray (5Y 6/2) dry; common medium prominent light olive brown (2.5Y 5/6) and common medium prominent strong brown (7.5YR 5/8) mottles; massive; very hard, very firm, very sticky and very plastic; few fine rounded and many medium irregularly shaped masses of gypsum; strong effervescence; mildly alkaline; gradual wavy boundary.

Cg3—42 to 60 inches; olive gray (5Y 5/2) clay, light olive gray (5Y 6/2) dry; many fine and medium prominent light olive brown (2.5Y 5/6) mottles; massive; hard, very firm, very sticky and very plastic; many large irregularly shaped masses of gypsum; few medium irregularly shaped masses of lime; strong effervescence; mildly alkaline.

The depth to lime ranges from 0 to 10 inches. The A horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 3 to 5 and chroma of 0 to 2. The Cg horizon has hue of 2.5Y to 5GY, or it is neutral in hue and has value of 3 to 7 (4 to 8 dry) and chroma of 0 to 2. It is silty clay loam, clay loam, or clay. Some pedons have a 2C horizon below a depth of 40 inches. This horizon is loam and contains as much as 10 percent gravel.

Spottswood Series

The Spottswood series consists of deep, moderately well drained soils on outwash plains. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 1 to 3 percent.

Typical pedon of Spottswood loam, 1 to 3 percent slopes, 1,240 feet south and 480 feet west of the northeast corner of sec. 31, T. 130 N., R. 64 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt smooth boundary.

Bw1—9 to 17 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; neutral; clear wavy boundary.

Bw2—17 to 23 inches; black (10YR 2/1) clay loam, very dark grayish brown (10YR 3/2) dry; weak coarse prismatic structure; soft, very friable, nonsticky and nonplastic; few fine roots; neutral; abrupt wavy boundary.

Bk1—23 to 28 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; few fine faint light yellowish brown (2.5Y 6/4) mottles; weak coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; violent effervescence; disseminated lime throughout; mildly alkaline; abrupt wavy boundary.

2Bk2—28 to 34 inches; light olive brown (2.5Y 5/4) gravelly loam, light yellowish brown (2.5Y 6/4) dry; few fine and medium prominent strong brown (7.5YR 5/8) mottles; massive; hard, friable,

nonsticky and nonplastic; about 20 percent gravel; common medium irregular seams of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

2C—34 to 60 inches; light olive brown (2.5Y 5/4) very gravelly coarse sand, light yellowish brown (2.5Y 6/4) dry; few fine prominent brown (7.5YR 5/4) mottles; single grain; loose, nonsticky and nonplastic; about 40 percent gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 34 inches. The depth to sand and gravel ranges from 20 to 40 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y. It is clay loam or loam. The Bk horizon has hue of 10YR or 2.5Y and value of 4 or 5 (5 to 7 dry). It is loam, clay loam, or gravelly loam. The 2C horizon has value of 4 to 6 (5 to 7 dry) and chroma of 2 to 4. It is loamy sand, gravelly sand, very gravelly coarse sand, gravelly coarse sand, or sand.

Stirum Series

The Stirum series consists of deep, poorly drained and very poorly drained, saline, sodic soils on lake plains and outwash plains. These soils formed in glaciolacustrine sediments and glaciofluvial deposits. Permeability is moderately slow in the upper part of the profile and rapid in the lower part. Slope is 0 to 1 percent.

Typical pedon of Stirum fine sandy loam, 300 feet west and 1,600 feet north of the southeast corner of sec. 29, T. 130 N., R. 59 W.

Ap—0 to 6 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine irregular filaments of salts; disseminated lime throughout; strong effervescence; mildly alkaline; abrupt smooth boundary.

Btz—6 to 10 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; strong very coarse prismatic structure parting to strong coarse and medium subangular blocky; extremely hard, firm, slightly sticky and slightly plastic; few fine and common very fine roots; common faint clay films on faces of peds; common medium irregularly shaped soft masses of salts; disseminated lime throughout; strong effervescence; mildly alkaline; gradual wavy boundary.

Btzg—10 to 18 inches; dark gray (5Y 4/1) fine sandy loam, gray (5Y 5/1) dry; moderate very coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm, sticky and slightly plastic; few very fine roots; common faint clay films on faces of peds; tongues of Btz material extending to a depth of 15 inches; common fine irregular filaments and threads of salts; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

Bzg—18 to 24 inches; dark gray (5Y 4/1) loamy fine sand, gray (5Y 6/1) dry; weak very coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and nonplastic; few very fine roots; dark gray (5Y 4/1) organic coatings on faces of peds; common fine round soft masses of salts; strong effervescence; strongly alkaline; gradual wavy boundary.

Bkzg—24 to 38 inches; light gray and gray (5Y 6/1) loamy fine sand, light gray (5Y 7/1) dry; weak very coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and nonplastic; dark gray (5Y 4/1) organic coatings on faces of peds; common medium irregularly shaped soft masses of salts; disseminated lime throughout; violent effervescence; strongly alkaline; gradual wavy boundary.

Cg1—38 to 44 inches; olive gray (5Y 5/2) loamy fine sand, light olive gray (5Y 6/2) dry; few fine distinct white (5Y 8/1) mottles; massive; slightly hard, very friable, slightly sticky and nonplastic; common medium irregularly shaped soft masses of salts; disseminated lime throughout; strong effervescence; moderately alkaline; clear wavy boundary.

Cg2—44 to 50 inches; olive gray (5Y 5/2) silt loam, light gray (5Y 7/1) dry; common fine distinct yellowish brown (10YR 5/6) mottles; massive; very hard, firm, sticky and slightly plastic; common medium irregularly shaped soft masses of salts; disseminated lime throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

2Cg3—50 to 56 inches; light olive gray (5Y 6/2) silt loam, white (N 8/0) dry; common fine distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) and few fine prominent dark brown (7.5YR 3/2) mottles; massive; hard, firm, sticky and slightly plastic; common medium irregularly shaped soft masses of salts; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

3Cg4—56 to 60 inches; dark grayish brown (10YR 4/2) and olive gray (5Y 5/2) loamy fine sand, brownish gray (10YR 6/2) and light gray or gray (5Y 6/1) dry; many medium distinct brown to dark brown (7.5YR

4/4) and common medium prominent black (5Y 2/1) mottles; massive; soft, loose, slightly sticky and nonplastic; common medium irregularly shaped soft masses of salts; disseminated lime throughout; strongly calcareous; moderately alkaline.

The A horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 2 or 3 (3 to 5 dry) and chroma of 0 to 2. Some pedons have an E horizon, which is 1 to 3 inches thick. The Bt horizon has value of 3 to 6 (4 to 8 dry) and chroma of 1 or 2. It is fine sandy loam, sandy loam, or loam. Some pedons have a Bw or Btk horizon. The Cg horizon is loamy fine sand, loamy sand, very fine sandy loam, or silt loam.

Svea Series

The Svea series consists of deep, moderately well drained, moderately slowly permeable soils on till plains. These soils formed in glacial till and alluvium. Slope ranges from 0 to 6 percent.

Typical pedon of Svea loam, in an area of Svea-Cresbard loams, 0 to 2 percent slopes; 360 feet west and 240 feet north of the southeast corner of sec. 9, T. 131 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

Bw1—8 to 14 inches; very dark gray (10YR 3/1) loam, very dark grayish brown (10YR 3/2) dry; moderate medium prismatic structure parting to strong medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; about 1 percent gravel; neutral; clear wavy boundary.

Bw2—14 to 24 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bw3—24 to 29 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bk—29 to 37 inches; light olive brown (2.5Y 5/4) clay loam, light brownish gray (2.5Y 6/2) dry; few fine distinct light olive brown (2.5Y 5/6) mottles; moderate medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; about 2 percent gravel; few fine irregularly shaped soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—37 to 60 inches; light olive brown (2.5Y 5/4) clay loam, light brownish gray (2.5Y 6/2) dry; common medium prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, sticky and slightly plastic; about 2 percent gravel; violent effervescence; moderately alkaline.

The content of gravel ranges from 1 to 10 percent throughout the profile. The thickness of the mollic epipedon ranges from 16 to more than 30 inches.

The A horizon has hue of 10YR, or it is neutral in hue and has value of 2 or 3 (3 to 5 dry) and chroma of 0 or 1. The Bw horizon has value and chroma of 2 to 4. It is loam or clay loam. The Bk horizon has hue of 10YR to 5Y, value of 4 to 6 (5 to 8 dry), and chroma of 2 to 4. Some pedons have a BC or BCk horizon. The C horizon has value of 4 or 5 (5 or 6 dry). Some pedons have a thin gravelly or stony layer at the boundary between the B and C horizons.

Swenoda Series

The Swenoda series consists of deep, moderately well drained soils on till plains and lake plains. These soils formed in eolian materials, glacial till, and glaciolacustrine sediments. Permeability is moderately rapid in the upper part of the profile and moderately slow in the lower part. Slope ranges from 1 to 3 percent.

Typical pedon of Swenoda fine sandy loam, 1 to 3 percent slopes, 1,890 feet south and 1,130 feet east of the northwest corner of sec. 32, T. 129 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few fine and common very fine roots; neutral; abrupt smooth boundary.

Bw1—8 to 18 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; neutral; clear wavy boundary.

Bw2—18 to 23 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; mildly alkaline; gradual wavy boundary.

Bw3—23 to 30 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry;

weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; mildly alkaline; clear wavy boundary.

2C1—30 to 34 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; disseminated lime throughout; slight effervescence; mildly alkaline; clear wavy boundary.

2C2—34 to 60 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common medium irregularly shaped soft masses of lime; strong effervescence; mildly alkaline.

The depth to lime and depth to the 2C horizon range from 20 to 40 inches. The A horizon generally has value of 2 or 3 (3 or 4 dry) and chroma of 1, but in some pedons it has dry chroma of 2 in the lower part. The Bw horizon has value of 2 to 4 (3 to 6 dry) and chroma of 1 to 3. It is fine sandy loam or sandy loam. The 2C horizon has value of 4 to 6 (6 to 8 dry) and chroma of 2 to 4. It is silt loam, silty clay loam, loam, or clay loam.

Tiffany Series

The Tiffany series consists of deep, poorly drained, moderately permeable soils on lake plains and outwash plains. These soils formed in glaciolacustrine sediments and glaciofluvial deposits. Slope is 0 to 1 percent.

Typical pedon of Tiffany fine sandy loam, in an area of Wyndmere-Tiffany fine sandy loams; 750 feet east and 80 feet south of the northwest corner of sec. 29, T. 129 N., R. 63 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; neutral; abrupt smooth boundary.

A—10 to 18 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and very fine roots; neutral; clear wavy boundary.

AC—18 to 30 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; common medium prominent dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; neutral; gradual wavy boundary.

C1—30 to 38 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; many coarse prominent dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots; common fine black (10YR 2/1) iron-manganese concretions; neutral; gradual wavy boundary.

C2—38 to 60 inches; dark grayish brown (2.5Y 4/2) loamy fine sand, light gray (2.5Y 7/2) dry; common medium prominent dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, very friable, nonsticky and nonplastic; disseminated lime throughout; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The depth to lime ranges from 20 to 40 inches.

The A horizon has hue of 10YR, or it is neutral in hue and has value of 3 to 5 dry and chroma of 0 or 1. The AC horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 3.

Tonka Series

The Tonka series consists of deep, poorly drained, slowly permeable soils on till plains and moraines. These soils formed in alluvium and glacial till. Slope is 0 to 1 percent.

Typical pedon of Tonka silt loam, 2,290 feet north and 500 feet west of the southeast corner of sec. 9, T. 131 N., R. 63 W.

Ap—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common fine and very fine and few medium roots; mildly alkaline; abrupt smooth boundary.

A—6 to 13 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; moderate medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine and very fine pores; mildly alkaline; gradual wavy boundary.

E—13 to 18 inches; very dark gray (10YR 3/1) silt loam, light gray (10YR 7/1) dry; many medium faint very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) mottles; moderate medium platy structure parting to weak fine granular; slightly hard, friable, nonsticky and nonplastic; few fine and very fine roots; common very fine and fine pores; mildly alkaline; clear wavy boundary.

Bt—18 to 25 inches; very dark gray (10YR 3/1) silty

clay, dark gray (10YR 4/1) dry; strong coarse prismatic structure; very hard, firm, sticky and plastic; few very fine roots; common faint clay films on faces of peds; neutral; gradual wavy boundary.

Btg—25 to 34 inches; dark gray (5Y 4/1) clay, gray (5Y 5/1) dry; few fine prominent brown (10YR 4/3) mottles; strong coarse prismatic structure; very hard, firm, sticky and plastic; common faint clay films on faces of peds; neutral; gradual wavy boundary.

BCg—34 to 43 inches; olive gray (5Y 4/2) silty clay loam, olive gray (5Y 5/2) dry; few fine prominent yellowish brown (10YR 5/6) mottles; strong coarse blocky structure; very hard, firm, slightly sticky and slightly plastic; mildly alkaline; gradual wavy boundary.

Cg—43 to 60 inches; olive (5Y 5/3) silty clay loam, pale olive (5Y 6/3) dry; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; hard, firm, nonsticky and nonplastic; moderately alkaline.

The depth to lime ranges from 20 to more than 60 inches. The A horizon has hue of 10YR, or it is neutral in hue. The E horizon has hue of 10YR or 2.5Y, or it is neutral in hue and has value of 3 to 5 (5 to 7 dry) and chroma of 0 to 2. It is loam, silt loam, very fine sandy loam, or silty clay loam. The Bt horizon has value of 2 to 4. It is clay loam, silty clay loam, silty clay, or clay.

Towner Series

The Towner series consists of deep, moderately well drained soils on lake plains and till plains. These soils formed in eolian materials and glaciolacustrine sediments. Permeability is rapid in the upper part of the profile and moderately slow in the lower part. Slope ranges from 0 to 3 percent.

Typical pedon of Towner loamy fine sand, 0 to 3 percent slopes, 2,320 feet north and 1,200 feet east of the southwest corner of sec. 31, T. 129 N., R. 59 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; neutral; abrupt smooth boundary.

A—9 to 17 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; neutral; clear wavy boundary.

C1—17 to 32 inches; olive brown (2.5Y 4/4) fine sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; mildly alkaline; abrupt wavy boundary.

2C2—32 to 60 inches; grayish brown (2.5Y 5/2) silt loam, pale yellow (2.5Y 7/4) dry; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; strong effervescence; moderately alkaline.

Depth to the 2C horizon ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 16 to 30 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The 2C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (6 to 8 dry), and chroma of 2 to 4. It is silt loam or silty clay loam.

Ulen Series

The Ulen series consists of deep, somewhat poorly drained, rapidly permeable, highly calcareous soils on lake plains and outwash plains. These soils formed in glaciolacustrine sediments and glaciofluvial deposits. Slope is 0 to 1 percent.

Typical pedon of Ulen fine sandy loam, 1,700 feet west and 1,600 feet south of the northeast corner of sec. 15, T. 130 N., R. 59 W.

A—0 to 12 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

Bk—12 to 16 inches; dark grayish brown (2.5Y 4/2) and light brownish gray (2.5Y 6/2) fine sandy loam, light gray or gray (N 6/0) and white (N 8/0) dry; weak medium blocky structure; loose, nonsticky and nonplastic; few very fine roots; common very fine pores; disseminated lime throughout; violent effervescence; moderately alkaline; abrupt smooth boundary.

Akb—16 to 20 inches; very dark grayish brown (2.5Y 3/2) fine sandy loam, gray (N 5/0) dry; common medium distinct light gray (N 7/0) mottles; weak medium blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg—20 to 36 inches; light olive gray (5Y 6/2) loamy fine sand, light gray (5Y 7/1) dry; few medium prominent black (10YR 2/1) mottles; weak coarse prismatic structure parting to weak medium blocky; soft, very friable, nonsticky and nonplastic; few very

fine roots; disseminated lime throughout; violent effervescence; moderately alkaline; clear smooth boundary.

Cg—36 to 42 inches; olive gray (5Y 5/2) fine sand, light gray (5Y 7/2) dry; single grain; loose, nonsticky and nonplastic; slight effervescence; moderately alkaline; clear smooth boundary.

C1—42 to 54 inches; dark grayish brown (2.5Y 4/2) fine sand, light gray (2.5Y 7/0) and light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; slight effervescence; mildly alkaline; clear smooth boundary.

C2—54 to 60 inches; dark grayish brown (2.5Y 4/2) fine sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bk horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 3. It is loamy sand, loamy fine sand, sandy loam, or fine sandy loam. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 to 6. It is fine sand, loamy fine sand, sand, coarse sand, or very fine sand.

Vallers Series

The Vallers series consists of deep, poorly drained, moderately slowly permeable, highly calcareous soils on till plains and moraines. These soils formed in glacial till. Slope is 0 to 1 percent.

Typical pedon of Vallers loam, 2,490 feet north and 2,370 feet west of the southeast corner of sec. 20, T. 129 N., R. 62 W.

A—0 to 8 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; mildly alkaline; abrupt smooth boundary.

ABk—8 to 17 inches; very dark grayish brown (2.5Y 3/2) clay loam, grayish brown (2.5Y 5/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; hard, firm, sticky and plastic; common fine and very fine roots; common large rounded masses of lime; slight effervescence; moderately alkaline; clear wavy boundary.

Bk—17 to 22 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine roots; about 1 percent gravel; few medium manganese concretions; lime disseminated throughout and in soft masses; violent effervescence; moderately alkaline; gradual wavy boundary.

Cg1—22 to 28 inches; olive gray (5Y 5/2) loam, light gray (5Y 7/2) dry; common medium prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; about 3 percent gravel; few medium manganese concretions; few fine rounded and oblong masses of lime; slight effervescence; moderately alkaline; gradual wavy boundary.

Cg2—28 to 60 inches; light olive gray (5Y 6/2) loam, light gray (5Y 7/2) dry; common medium and fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, firm, slightly sticky and slightly plastic; about 3 percent gravel; few medium manganese concretions; common medium rounded and oblong masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 25 inches. The content of gravel ranges from 2 to 8 percent throughout the profile. The soil is saline in some pedons.

The A horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 2 or 3 and chroma of 0 or 1. The Bk horizon has hue of 10YR to 5Y, or it is neutral in hue and has value of 3 to 6 and chroma of 0 to 2. It is clay loam, silty clay loam, or sandy clay loam. The Cg horizon has hue of 2.5Y or 5Y, value of 4 to 7, and chroma of 1 to 3. It is loam or clay loam.

Vang Series

The Vang series consists of deep, well drained soils on outwash plains and terraces. These soils formed in glaciofluvial deposits. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 1 to 3 percent.

Typical pedon of Vang loam, in an area of Brantford-Vang loams, 1 to 3 percent slopes; 1,730 feet west and 250 feet south of the northeast corner of sec. 3, T. 131 N., R. 64 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; neutral; clear wavy boundary.

A—9 to 14 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky

and slightly plastic; many very fine roots; neutral; clear wavy boundary.

Bw—14 to 22 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; slight effervescence in the lower part; mildly alkaline; clear wavy boundary.

Bk—22 to 32 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; about 1 percent gravel; disseminated lime throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

2C—32 to 60 inches; dark grayish brown (2.5Y 4/2) very gravelly loamy coarse sand, light brownish gray (2.5Y 6/2) dry; massive; loose, nonsticky and nonplastic; few very fine roots; about 40 percent shale gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 33 inches. The depth to sand and gravel ranges from 20 to 40 inches.

The A horizon has value of 2 or 3 (3 or 4 dry). The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4 (4 to 6 dry), and chroma of 1 to 3. It is loam or clay loam. The content of gravel in the Bk horizon ranges from 1 to 10 percent. The 2C horizon has hue of 2.5Y or 5Y, value of 2 to 6 (5 to 7 dry), and chroma of 1 to 4. It ranges from 30 to 80 percent gravel.

Wabek Series

The Wabek series consists of deep, excessively drained, very rapidly permeable soils on outwash plains. These soils formed in glaciofluvial deposits. Slope ranges from 1 to 25 percent.

Typical pedon of Wabek loam, 6 to 25 percent slopes, 2,450 feet west and 2,050 feet south of the northeast corner of sec. 17, T. 131 N., R. 65 W.

A—0 to 6 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; mildly alkaline; abrupt irregular boundary.

2C1—6 to 14 inches; dark grayish brown (10YR 4/2) gravelly coarse sand, light brownish gray (10YR 6/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; about 20 percent gravel; lime coatings on undersides of pebbles; slight effervescence; mildly alkaline; diffuse irregular boundary.

2C2—14 to 60 inches; dark yellowish brown (10YR 4/4) very gravelly coarse sand, yellowish brown (10YR 5/4) dry; single grain; loose, nonsticky and nonplastic; about 40 percent gravel; slight effervescence; mildly alkaline.

The depth to sand and gravel ranges from 4 to 14 inches. The depth to lime ranges from 0 to 9 inches. The thickness of the mollic epipedon ranges from 7 to 10 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). The content of gravel in the 2C horizon ranges from 35 to 70 percent.

Williams Series

The Williams series consists of deep, well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 1 to 25 percent.

Typical pedon of Williams loam, in an area of Williams-Bowbells loams, 3 to 6 percent slopes; 75 feet north and 40 feet east of the southwest corner of sec. 5, T. 130 N., R. 65 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; about 1 percent gravel; mildly alkaline; abrupt smooth boundary.

Bt1—7 to 11 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; strong coarse prismatic structure parting to strong medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common faint clay films on faces of peds; very dark grayish brown (10YR 3/2) organic stains on faces of peds; about 2 percent gravel; mildly alkaline; clear wavy boundary.

Bt2—11 to 19 inches; dark brown (10YR 4/3) clay loam, brown (10YR 6/4) dry; moderate medium prismatic structure parting to strong medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common faint clay films on faces of peds; very dark grayish brown (10YR 3/2) organic stains on faces of peds; about 2 percent gravel; mildly alkaline; clear wavy boundary.

Bk—19 to 34 inches; olive brown (2.5Y 4/4) loam, light olive brown (2.5Y 5/4) dry; weak medium prismatic structure; hard, friable, slightly sticky and slightly plastic; few roots; common pores; about 5 percent

gravel; lime disseminated throughout and in common fine irregularly shaped small masses and filaments; strong effervescence; moderately alkaline; gradual wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 4/6) and gray (10YR 5/1) mottles; massive; hard, firm, slightly sticky and slightly plastic; about 3 percent gravel; slight effervescence; moderately alkaline.

The depth to lime ranges from 10 to 30 inches. The content of gravel ranges from 1 to 10 percent throughout the profile.

The A horizon has value of 2 or 3 (3 to 5 dry). The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is loam or clay loam. The C horizon has hue of 2.5Y or 5Y, value of 3 to 6 (5 to 8 dry), and chroma of 2 to 4. It is loam or clay loam.

Wyard Series

The Wyard series consists of deep, somewhat poorly drained, moderately permeable soils on till plains. These soils formed in alluvium and glacial till. Slope ranges from 0 to 3 percent.

Typical pedon of Wyard loam, in an area of Hamerly-Wyard loams, 0 to 3 percent slopes; 1,790 feet east and 1,380 feet north of the southwest corner of sec. 29, T. 129 N., R. 60 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral; abrupt smooth boundary.

A—7 to 19 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many very fine roots; few clean grains of silt and sand on faces of peds; mildly alkaline; clear wavy boundary.

Bw—19 to 25 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; common fine prominent strong brown (7.5YR 4/6) mottles; strong coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; common very fine roots; mildly alkaline; gradual wavy boundary.

Bk—25 to 34 inches; light yellowish brown (2.5Y 6/4) loam, light gray (2.5Y 7/2) dry; many fine distinct olive yellow (2.5Y 6/6) mottles; weak moderate prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots in the upper part; lime disseminated throughout and in common fine filaments; violent effervescence; moderately alkaline; gradual wavy boundary.

C—34 to 60 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; many large distinct light olive brown (2.5Y 5/6) mottles; massive; about 2 percent gravel; few large irregularly shaped soft masses of lime; slight effervescence; moderately alkaline.

The depth to lime ranges from 22 to 48 inches. The thickness of the mollic epipedon ranges from 16 to 24 inches.

The A horizon has value of 2 or 3 (3 to 5 dry). In some pedons it has few or common distinct mottles in the lower part. The Bw horizon has hue of 10YR to 5Y, value of 3 or 4 (4 to 6 dry), and chroma of 1 to 4. It is loam or silt loam. The Bk horizon has hue of 2.5Y or 5Y and value of 5 to 8 dry. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is loam, sandy loam, or clay loam.

Wyndmere Series

The Wyndmere series consists of deep, somewhat poorly drained, moderately rapidly permeable soils on lake plains and outwash plains. These soils formed in glaciolacustrine sediments and glaciofluvial deposits. Slope is 0 to 1 percent.

Typical pedon of Wyndmere fine sandy loam, in an area of Wyndmere-Tiffany fine sandy loams; 1,760 feet south and 150 feet west of the northeast corner of sec. 31, T. 129 N., R. 63 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bk—8 to 26 inches; light brownish gray (2.5Y 6/2) fine sandy loam, light gray (10YR 7/1) dry; moderate coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

C1—26 to 41 inches; olive brown (2.5Y 4/4) fine sandy loam, light brownish gray (2.5Y 6/2) dry; many fine distinct pale yellow (2.5Y 7/4) mottles; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; strong

effervescence; moderately alkaline; gradual wavy boundary.

C2—41 to 54 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; many large prominent very dark grayish brown (10YR 3/2) and yellowish brown (10YR 5/6) mottles; massive; soft, very friable, nonsticky and nonplastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—54 to 60 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; common medium prominent yellowish brown (10YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The A horizon has value of 1 to 5 and chroma of 1 or 2. The Bk horizon has hue of 2.5Y or 10YR, value of 3 to 5 (4 to 7 dry), and chroma of 1 or 2. The C horizon has hue of 2.5Y, 10YR, or, rarely, 5Y. It has value of 4 to 7 (5 to 8 dry).

Zahl Series

The Zahl series consists of deep, well drained, moderately slowly permeable soils on till plains and moraines. These soils formed in glacial till. Slope ranges from 3 to 45 percent.

Typical pedon of Zahl loam, in an area of Zahl-Williams loams, 6 to 25 percent slopes; 1,520 feet south and 150 feet west of the northeast corner of sec. 13, T. 130 N., R. 66 W.

A—0 to 5 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; about 3 percent gravel; slight effervescence; moderately alkaline; clear wavy boundary.

Bk—5 to 20 inches; olive brown (2.5Y 4/4) loam, light brownish gray (2.5Y 6/2) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; about 5 percent gravel; lime disseminated throughout and in common fine rounded soft masses; strong effervescence; moderately alkaline; gradual wavy boundary.

C—20 to 60 inches; olive brown (2.5Y 4/4) clay loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 4/6) and few medium prominent dark reddish brown (5YR 3/4) mottles; massive; hard, friable, sticky and plastic; about 5 percent gravel; common fine round soft masses of lime; strong effervescence; moderately alkaline.

The content of gravel ranges from 1 to 10 percent throughout the profile. The A horizon has hue of 10YR or 2.5Y and value of 2 or 3 (3 to 5 dry). The Bk horizon has hue of 10YR or 2.5Y and value of 4 to 6 (5 to 7 dry). Some pedons have a BCk horizon. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4.

Formation of the Soils

Soils form through the physical and chemical weathering of deposited or accumulated geologic material. Soil characteristics are determined by the physical traits and chemical and mineralogical composition of the parent material; the climate under which the soil formed and has existed since formation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the processes of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are very influential factors of soil formation. They determine the nature of weathering and slowly change the parent material into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief and the parent material. Finally, time is needed for the climatic and biological forces to weather the parent material and form a soil. Time also is required for the differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Parent Material

The soils in Dickey County formed in glacial drift. The advancing glacier picked up rocks and soil and ground and mixed them. This ground and mixed material was then deposited as the ice melted from the receding glacier. Some soils, such as Barnes and Svea soils, formed in unsorted material or glacial till. Other soils, such as Overly and Aberdeen soils, formed in glaciolacustrine deposits. Still other soils, such as Sioux and Hecla soils, formed in glacial outwash. The parent material of the soils on flood plains and terraces is alluvium deposited by the floodwater of streams. These soils are stratified and subject to flooding. Some have an old, buried surface layer. Lamoure and La Prairie soils, which are along the James and Maple Rivers and along some of the larger creeks, are examples of soils that formed in alluvium.

Climate

Climate has direct and indirect effects on the formation of soils. Precipitation, temperature, and wind directly affect the weathering and reworking of soil material. The climate indirectly influences soil formation through its effects on the amount and kind of vegetation and animal life on or in the soil.

In addition to weathering soil material, precipitation and temperature affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil. Freezing and thawing help to break down soil particles in the parent material, thereby providing more surface area for chemical processes. Cool temperatures affect the content of organic matter by slowing the decay of plant material and animal remains.

Dickey County has a continental, semiarid climate characterized by long, cold winters and short, warm summers. Most of the precipitation falls during the growing season and is distributed in an erratic pattern. The climate is fairly uniform throughout the county.

Plant and Animal Life

The soils in Dickey County formed mainly under grassland vegetation. Grasses provide a plentiful supply of organic matter, which improves the chemical and physical properties of the soil. The fibrous roots of these grasses penetrate the soil to a depth of several feet, making it more porous and more granular. As a result of these changes in the soil, less water runs off the surface and more moisture is available for increased microbiological activity. The decay of the plants improves the available water capacity, tilth, and fertility of the soil. The decayed organic matter, accumulating over long periods, gives the surface layer its dark color.

Micro-organisms have important effects on soil formation because they feed on undecomposed organic matter and convert it into humus from which plants can

obtain nutrients. Bacteria and different kinds of fungi attack leaves and other forms of organic matter. Insects, earthworms, and small burrowing animals help to mix the humus with the soil.

Relief

The slope of the soils in Dickey County ranges from level to very steep. The degree of slope and the shape of the surface influence each soil through their effects on runoff and internal drainage.

The profile of soils that formed in depressions differs from that of soils that formed in steep areas. Tonka soils, which are in depressions, exhibit an advanced degree of horizonation because of the alternate wetting and drying cycle that occurs in the depressions. In contrast, the steeply sloping Buse soils exhibit a minimal degree of horizonation. Barnes, Svea, and other soils that have gentle slopes generally support a more luxuriant plant cover than the steeper soils and have a more strongly expressed profile.

Time

Soil formation is a very slow process. Much time is required for the processes of soil formation to act on the parent material and to form distinct horizons within the soil profile. Approximately 10,000 years have passed since the glacier receded from Dickey County. In geologic terms, the soils in the county are young.

More time has been available for the formation of Svea soils on glacial till plains than for the formation of Serden soils on outwash plains adjacent to glacial Lake Dakota. The processes of soil formation have been continually acting on the parent material of the Svea soils. The Serden soils, however, were exposed as a result of recent erosion.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fibric soil material (peat). The least decomposed of all

organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain. A nearly level surface marking the floor of an extinct lake filled in by well-sorted, stratified sediments.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-sodic soil. A soil containing a combination of soluble salts and exchangeable sodium sufficient

to interfere with the growth of plants.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey area the slope classes are:

Level	0 to 1 percent
Level and nearly level	0 to 3 percent
Nearly level	1 to 3 percent
Gently sloping or undulating	3 to 6 percent
Moderately sloping or gently rolling	6 to 9 percent
Strongly sloping or rolling	9 to 15 percent
Moderately steep or hilly	15 to 25 percent
Steep	25 to 35 percent
Very steep	more than 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently

practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-86 at Ellendale, North Dakota)

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average daily	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Temperature: Average number of growing degree days*	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	19.4	-1.6	8.9	47	5	0	0.42	0.08	0.64	2	6.3
February	26.6	5.6	16.1	53	5	13	.46	.10	.72	2	6.1
March	38.3	17.5	27.9	68	5	56	.76	.19	1.17	2	6.0
April	56.7	31.4	44.1	87	8	185	2.22	.68	3.43	5	3.2
May	70.1	42.4	56.3	90	22	505	2.98	1.45	4.21	6	.1
June	78.2	52.2	65.2	95	37	756	3.88	1.79	5.47	7	.0
July	85.4	57.8	71.6	103	44	980	2.61	1.04	3.80	6	.0
August	84.5	55.7	70.1	102	38	933	2.33	1.08	3.30	5	.0
September	73.2	44.9	59.1	98	25	573	1.97	.57	3.08	4	.0
October	60.5	34.3	47.4	86	13	255	1.41	.31	2.18	3	.7
November	39.9	18.9	29.4	69	13	41	.57	.09	.82	2	4.3
December	25.4	5.5	15.5	53	13	18	.37	.07	.59	2	5.2
Yearly:											
Average	54.9	30.5	42.6	---	---	---	---	---	---	---	---
Extreme	---	---	---	104	13	---	---	---	---	---	---
Total	---	---	---	---	---	4,315	19.98	15.58	24.10	46	31.9

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-86 at Ellendale, North Dakota)

Probability	Temperature 24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 9	May 18	May 28
2 years in 10 later than--	May 3	May 13	May 23
5 years in 10 later than--	Apr. 21	May 4	May 14
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 29	Sept. 23	Sept. 12
2 years in 10 earlier than--	Oct. 4	Sept. 28	Sept. 17
5 years in 10 earlier than--	Oct. 13	Oct. 7	Sept. 25

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-86 at Ellendale, North Dakota)

Probability	Daily minimum temperature during growing season: Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	155	137	118
8 years in 10	161	143	123
5 years in 10	174	155	133
2 years in 10	187	167	143
1 year in 10	193	173	148

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
2	Overly-Aberdeen silt loams	1,410	0.2
3	Aberdeen-Exline silt loams	540	0.1
4	Rosewood fine sandy loam	1,750	0.2
6	Parnell silty clay loam	13,430	1.8
7	Southam silt loam	15,840	2.2
8	Tonka silt loam	6,620	0.9
9	Bearden silt loam	1,930	0.3
10	Glyndon silt loam, saline	1,730	0.3
12B	Arvilla fine sandy loam, 1 to 6 percent slopes	1,570	0.2
13	Rosewood fine sandy loam, wet	690	0.1
14	Barnes-Gardena loams, 1 to 3 percent slopes	3,400	0.5
15	Barnes-Svea loams, 1 to 3 percent slopes	102,780	14.1
15B	Barnes-Svea loams, 3 to 6 percent slopes	70,700	9.8
16B	Barnes-Cresbard loams, 2 to 6 percent slopes	18,000	2.5
17B	Barnes-Buse loams, 3 to 6 percent slopes	17,160	2.3
17C	Barnes-Buse loams, 6 to 9 percent slopes	16,920	2.3
18B	Barnes-Cavour loams, 1 to 6 percent slopes	41,060	5.7
19E	Buse-Barnes loams, 9 to 25 percent slopes	7,070	1.0
21	Cavour-Miranda loams, 1 to 3 percent slopes	24,910	3.4
22	Colvin silt loam	4,430	0.6
23	Colvin silt loam, wet	890	0.1
24	Gardena loam, 0 to 3 percent slopes	4,220	0.6
25	Divide loam, 0 to 2 percent slopes	4,920	0.7
26B	Eckman-Gardena silt loams, 3 to 6 percent slopes	2,760	0.4
27B	Embden sandy loam, 1 to 6 percent slopes	7,220	1.0
28B	Clontarf fine sandy loam, 1 to 6 percent slopes	3,570	0.5
29	Glyndon silt loam, 0 to 3 percent slopes	2,820	0.4
31	Edgeley loam, 1 to 3 percent slopes	6,080	0.8
31B	Edgeley loam, 3 to 6 percent slopes	2,560	0.3
33	Hecla loamy fine sand, 0 to 3 percent slopes	9,540	1.3
34	Hecla-Hamar loamy fine sands, 0 to 3 percent slopes	3,260	0.4
35	Fordville loam, 1 to 3 percent slopes	3,320	0.5
36	Hecla-Ulen complex, 0 to 3 percent slopes	2,410	0.3
37	Forman-Cavour loams, 1 to 3 percent slopes	13,680	1.9
38	Miranda-Cavour loams, 1 to 3 percent slopes	4,450	0.6
39	Hamar loamy fine sand	1,000	0.1
40	Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes	62,110	8.6
41	Colvin silt loam, saline	2,540	0.3
42	Hamerly-Wyard loams, 0 to 3 percent slopes	10,840	1.5
43	Exline silt loam	1,190	0.2
44	Harriet loam	12,120	1.7
46	Ludden clay	2,830	0.4
47	La Prairie loam, channeled	4,460	0.6
48	La Prairie loam	6,560	0.9
49	Lamoure silt loam	4,700	0.6
50	Wyndmere-Tiffany fine sandy loams	4,450	0.6
51	Kratka-Letcher fine sandy loams, 0 to 2 percent slopes	2,320	0.3
52C	Brantford-Coe loams, 3 to 9 percent slopes	2,700	0.4
53	Brantford-Vang loams, 1 to 3 percent slopes	3,990	0.5
54	Maddock fine sandy loam, 1 to 3 percent slopes	2,410	0.3
56	Overly silt loam	2,720	0.4
57	Ryan-Ludden complex	2,710	0.4
58	Renshaw loam	4,450	0.6
59	Pits	340	*
60B	Renshaw-Sioux loams, 1 to 6 percent slopes	8,410	1.1
61D	Sioux loam, 1 to 15 percent slopes	3,680	0.5
62C	Sioux-Barnes loams, 3 to 9 percent slopes	1,630	0.2
64	Sinai silty clay, 0 to 2 percent slopes	2,000	0.3
65B	Serden-Hamar complex, 0 to 6 percent slopes	1,190	0.2
66	Spottswood loam, 1 to 3 percent slopes	5,900	0.8
67	Stirum fine sandy loam	3,700	0.5

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
68	Stirum-Letcher fine sandy loams	890	0.1
69	Letcher fine sandy loam	1,060	0.1
70	Svea loam	7,460	1.0
71	Svea-Cresbard loams, 0 to 2 percent slopes	10,240	1.4
72	Swenoda fine sandy loam, 1 to 3 percent slopes	3,000	0.4
73	Swenoda-Letcher fine sandy loams, 1 to 3 percent slopes	5,680	0.8
74	Swenoda-Barnes complex, 1 to 3 percent slopes	9,390	1.3
77	Towner loamy fine sand, 0 to 3 percent slopes	1,410	0.2
78	Ulen fine sandy loam	8,270	1.1
79	Ulen-Hamar complex	510	0.1
80	Makoti-Sakakawea silt loams, 1 to 3 percent slopes	1,170	0.2
81B	Makoti-Sakakawea silt loams, 3 to 6 percent slopes	1,790	0.2
85B	Lehr-Wabek loams, 1 to 6 percent slopes	4,880	0.7
86E	Wabek loam, 6 to 25 percent slopes	7,470	1.0
90	Vallers loam	4,990	0.7
91B	Ruso sandy loam, 1 to 6 percent slopes	1,090	0.1
92B	Williams-Bowbells loams, 3 to 6 percent slopes	17,330	2.4
93C	Williams-Zahl loams, 6 to 9 percent slopes	19,240	2.6
94C	Williams loam, 3 to 9 percent slopes, very stony	1,770	0.2
95B	Bowbells-Zahl loams, 3 to 6 percent slopes	1,540	0.2
96E	Zahl-Williams loams, 6 to 25 percent slopes	24,280	3.3
97F	Zahl-Max loams, 15 to 45 percent slopes	4,830	0.7
98D	Williams-Zahl-Parnell complex, 0 to 15 percent slopes	3,020	0.4
	Water	3,800	0.5
	Total	729,700	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Spring wheat	Barley	Sunflowers	Corn	Bromegrass-alfalfa hay
	Bu	Bu	Lbs	Bu	Tons
2 Overly-Aberdeen	34	55	1,700	70	2.3
3 Aberdeen-Exline	20	33	1,000	44	1.4
4 Rosewood	20	33	1,000	58	2.8
6 Parnell	12	20	600	46	---
7. Southam					
8 Tonka	17	28	850	54	2.8
9 Bearden	36	59	1,800	66	2.3
10 Glyndon	17	28	850	52	2.1
12B Arvilla	16	26	800	33	1.8
13 Rosewood	5	8	250	---	2.8
14 Barnes-Gardena	37	60	1,850	72	2.6
15 Barnes-Svea	35	57	1,750	68	2.7
15B Barnes-Svea	30	49	1,500	59	2.6
16B Barnes-Cresbard	28	46	1,400	54	2.2
17B Barnes-Buse	27	44	1,350	52	2.1
17C Barnes-Buse	22	36	1,100	43	2.1
18B Barnes-Cavour	24	39	1,200	47	2.1
19E. Buse-Barnes					
21 Cavour-Miranda	14	23	700	16	1.3
22 Colvin	22	36	1,100	26	2.8

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Barley	Sunflowers	Corn	Bromegrass-alfalfa hay
	Bu	Bu	Lbs	Bu	Tons
23----- Colvin	5	8	250	---	2.8
24----- Gardena	39	63	1,950	79	2.6
25----- Divide	20	33	1,000	46	2.3
26B----- Eckman-Gardena	33	54	1,650	70	2.6
27B----- Embden	30	49	1,500	76	2.1
28B----- Clontarf	25	41	1,250	29	2.1
29----- Glyndon	32	52	1,600	68	2.3
31----- Edgeley	30	49	1,500	59	1.9
31B----- Edgeley	27	44	1,350	52	1.9
33----- Hecla	22	36	1,100	76	1.8
34----- Hecla-Hamar	20	33	1,000	79	2.1
35----- Fordville	24	39	1,200	48	2.6
36----- Hecla-Ulen	20	33	1,000	74	2.0
37----- Forman-Cavour	29	47	1,450	51	2.1
38----- Miranda-Cavour	---	---	---	---	1.1
39----- Hamar	20	33	1,000	80	2.8
40----- Hamerly-Tonka-Parnell	30	49	1,500	60	2.5
41----- Colvin	8	13	400	13	2.1
42----- Hamerly-Wyard	34	55	1,700	51	2.5
43----- Exline	---	---	---	---	0.9
44----- Harriet	---	---	---	---	1.6

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Barley	Sunflowers	Corn	Bromegrass-alfalfa hay
	Bu	Bu	Lbs	Bu	Tons
46----------------------- Ludden	24	39	1,200	44	2.8
47----------------------- La Prairie	---	---	---	---	2.8
48----------------------- La Prairie	39	63	1,950	78	2.8
49----------------------- Lamoure	29	47	1,450	33	2.8
50----------------------- Wyndmere-Tiffany	28	46	1,400	70	2.5
51----------------------- Kratka-Letcher	20	33	1,000	58	2.4
52C---------------------- Brantford-Coe	8	13	400	---	1.5
53----------------------- Brantford-Vang	21	34	1,050	42	2.1
54----------------------- Maddock	23	37	1,150	54	2.1
56----------------------- Overly	38	62	1,900	71	2.6
57----------------------- Ryan-Ludden	---	---	---	---	1.8
58----------------------- Renshaw	13	21	650	26	1.8
59*. Pits					
60B---------------------- Renshaw-Sioux	14	23	700	28	1.5
61D---------------------- Sioux	---	---	---	---	1.0
62C---------------------- Sioux-Barnes	---	---	---	---	1.7
64----------------------- Sinai	36	59	1,800	67	2.2
65B. Serden-Hamar					
66----------------------- Spottswood	28	46	1,400	54	2.6
67----------------------- Stirum	---	---	---	---	1.6

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Barley	Sunflowers	Corn	Bromegrass-alfalfa hay
	Bu	Bu	Lbs	Bu	Tons
68----------------------- Stirum-Letcher	---	---	---	---	1.5
69----------------------- Letcher	10	16	500	33	1.4
70----------------------- Svea	36	59	1,800	71	2.8
71----------------------- Svea-Cresbard	34	55	1,700	65	2.3
72----------------------- Swenoda	29	47	1,450	69	2.1
73----------------------- Swenoda-Letcher	26	42	1,300	62	1.9
74----------------------- Swenoda-Barnes	31	50	1,550	74	2.3
77----------------------- Towner	22	36	1,100	63	1.8
78----------------------- Ulen	22	36	1,100	71	2.3
79----------------------- Ulen-Hamar	22	36	1,100	72	2.6
80----------------------- Makoti-Sakakawea	27	44	1,350	59	1.8
81B---------------------- Makoti-Sakakawea	24	39	1,200	53	1.8
85B---------------------- Lehr-Wabek	11	18	550	24	1.3
86E---------------------- Wabek	---	---	---	---	0.9
90----------------------- Vallers	28	46	1,400	45	2.8
91B---------------------- Ruso	13	21	650	29	1.6
92B---------------------- Williams-Bowbells	27	44	1,350	59	2.4
93C---------------------- Williams-Zahl	21	34	1,050	46	1.8
94C---------------------- Williams	---	---	---	---	2.3
95B---------------------- Bowbells-Zahl	24	39	1,200	53	1.8

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Barley	Sunflowers	Corn	Bromegrass-alfalfa hay
	Bu	Bu	Lbs	Bu	Tons
96E Zahl-Williams	---	---	---	---	1.6
97F. Zahl-Max					
98D Williams-Zahl-Parnell	---	---	---	---	2.1

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
2*:				
Overly	Silty	3,400	2,900	2,500
Aberdeen	Clayey	2,800	2,400	2,000
3*:				
Aberdeen	Clayey	2,800	2,400	2,000
Exline	Thin Claypan	1,300	1,100	900
4 Rosewood	Subirrigated	4,800	4,400	3,900
6 Parnell	Wetland	6,000	5,500	5,000
8 Tonka	Wet Meadow	5,000	4,500	4,000
9 Bearden	Limy Subirrigated	4,800	4,200	3,600
10 Glyndon	Saline Lowland	3,500	3,200	2,800
12B Arvilla	Shallow to Gravel	2,100	1,900	1,600
13 Rosewood	Wetland	7,000	6,600	6,000
14*:				
Barnes	Silty	3,200	2,700	2,300
Gardena	Silty	3,400	2,900	2,500
15*:				
Barnes	Silty	3,200	2,700	2,300
Svea	Overflow	4,000	3,600	3,100
15B*:				
Barnes	Silty	3,200	2,700	2,300
Svea	Silty	3,500	3,000	2,600
16B*:				
Barnes	Silty	3,200	2,700	2,300
Cresbard	Clayey	2,800	2,400	2,000
17B*, 17C*:				
Barnes	Silty	3,200	2,700	2,300
Buse	Thin Upland	2,800	2,500	2,100

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
18B*:				
Barnes	Silty	3,200	2,700	2,300
Cavour	Claypan	2,300	2,000	1,600
19E*:				
Buse	Thin Upland	2,800	2,500	2,100
Barnes	Silty	3,200	2,700	2,300
21*:				
Cavour	Claypan	2,300	2,000	1,600
Miranda	Thin Claypan	1,300	1,100	900
22 Colvin	Wet Meadow	5,000	4,500	4,000
23 Colvin	Wetland	7,000	6,600	6,000
24 Gardena	Silty	3,400	2,900	2,500
25 Divide	Limy Subirrigated	4,800	4,200	3,600
26B*:				
Eckman	Silty	3,200	2,700	2,300
Gardena	Silty	3,400	2,900	2,500
27B Embden	Sandy	3,200	2,800	2,400
28B Clontarf	Sandy	3,200	2,800	2,400
29 Glyndon	Limy Subirrigated	4,800	4,200	3,600
31, 31B Edgeley	Silty	2,600	2,300	1,900
33 Hecla	Sands	3,300	2,900	2,500
34*:				
Hecla	Sands	3,300	2,900	2,500
Hamar	Subirrigated	4,800	4,400	3,900
35 Fordville	Silty	3,100	2,600	2,200
36*:				
Hecla	Sands	3,300	2,900	2,500
Ulen	Limy Subirrigated	4,800	4,200	3,600

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
37*:				
Forman	Silty	3,200	2,700	2,300
Cavour	Claypan	2,300	2,000	1,600
38*:				
Miranda	Thin Claypan	1,300	1,100	900
Cavour	Claypan	2,300	2,000	1,600
39 Hamar	Subirrigated	4,800	4,400	3,900
40*:				
Hamerly	Limy Subirrigated	4,800	4,200	3,600
Tonka	Wet Meadow	5,000	4,500	4,000
Parnell	Wetland	7,000	6,600	6,000
41 Colvin	Saline Lowland	3,500	3,200	2,800
42*:				
Hamerly	Limy Subirrigated	4,800	4,200	3,600
Wyard	Overflow	4,000	3,600	3,100
43 Exline	Thin Claypan	1,300	1,100	900
44 Harriet	Saline Lowland	3,200	2,800	2,400
46 Ludden	Overflow	4,000	3,600	3,100
47 La Prairie	Overflow	4,200	3,700	3,200
48 La Prairie	Silty	3,500	3,000	2,600
49 Lamoure	Subirrigated	4,800	4,400	3,900
50*:				
Wyndmere	Limy Subirrigated	4,800	4,200	3,600
Tiffany	Subirrigated	4,800	4,400	3,900
51*:				
Kratka	Subirrigated	4,800	4,400	3,900
Letcher	Sandy Claypan	3,800	2,800	1,800
52C*:				
Brantford	Shallow to Gravel	2,100	1,900	1,600
Coe	Very Shallow	1,200	1,000	800

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
53*:				
Brantford	Shallow to Gravel	2,100	1,900	1,600
Vang	Silty	3,100	2,600	2,200
54 Maddock	Sandy	3,200	2,800	2,400
56 Overly	Silty	3,400	2,900	2,500
57*:				
Ryan	Thin Claypan	1,300	1,100	900
Ludden	Saline Lowland	3,500	3,200	2,800
58 Renshaw	Shallow to Gravel	2,100	1,900	1,600
60B*:				
Renshaw	Shallow to Gravel	2,100	1,900	1,600
Sioux	Very Shallow	1,200	1,000	800
61D Sioux	Very Shallow	1,200	1,000	800
62C*:				
Sioux	Very Shallow	1,200	1,000	800
Barnes	Silty	3,200	2,700	2,300
64 Sinai	Clayey	3,100	2,700	2,300
65B*:				
Serden	Thin Sands	2,400	2,100	1,800
Hamar	Subirrigated	4,800	4,400	3,900
66 Spottswood	Silty	3,200	2,700	2,300
67 Stirum	Subirrigated	4,800	4,400	3,900
68*:				
Stirum	Subirrigated	4,800	4,400	3,900
Letcher	Sandy Claypan	3,800	2,800	1,800
69 Letcher	Sandy Claypan	3,800	2,800	1,800
70 Svea	Overflow	4,000	3,600	3,100

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
71*:				
Svea	Overflow	4,000	3,600	3,100
Cresbard	Clayey	2,800	2,400	2,000
72 Swenoda	Sandy	3,200	2,800	2,400
73*:				
Swenoda	Sandy	3,200	2,800	2,400
Letcher	Sandy Claypan	3,800	2,800	1,800
74*:				
Swenoda	Sandy	3,200	2,800	2,400
Barnes	Silty	3,200	2,700	2,300
77 Towner	Sands	3,300	2,900	2,500
78 Ulen	Limy Subirrigated	4,800	4,200	3,600
79*:				
Ulen	Limy Subirrigated	4,800	4,200	3,600
Hamar	Subirrigated	4,800	4,400	3,900
80*, 81B*:				
Makoti	Silty	2,600	2,200	1,800
Sakakawea	Thin Upland	2,300	1,900	1,600
85B*:				
Lehr	Shallow to Gravel	1,900	1,600	1,300
Wabek	Very Shallow	1,000	800	600
86E Wabek	Very Shallow	1,000	800	600
90 Vallers	Subirrigated	4,800	4,400	3,900
91B Ruso	Sandy	2,400	2,000	1,600
92B*:				
Williams	Silty	2,500	2,100	1,700
Bowbells	Silty	2,700	2,300	1,900
93C*:				
Williams	Silty	2,500	2,100	1,700
Zahl	Thin Upland	2,300	1,900	1,600
94C Williams	Silty	2,500	2,100	1,700

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
95B*:				
Bowbells	Silty	2,700	2,300	1,900
Zahl	Thin Upland	2,300	1,900	1,600
96E*:				
Zahl	Thin Upland	2,300	1,900	1,600
Williams	Silty	2,500	2,100	1,700
97F*:				
Zahl	Thin Upland	2,300	1,900	1,600
Max	Silty	2,500	2,100	1,700
98D*:				
Williams	Silty	2,500	2,100	1,700
Zahl	Thin Upland	2,300	1,900	1,600
Parnell	Wetland	6,000	5,500	5,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
2*:					
Overly	---	Siberian peashrub, ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
Aberdeen	---	Eastern redcedar, Siberian peashrub, Russian olive, lilac, Peking cotoneaster, common chokecherry, silver buffaloberry.	Siberian elm, Siberian crabapple, green ash, ponderosa pine.	---	---
3*:					
Aberdeen	---	Eastern redcedar, Siberian peashrub, Russian olive, lilac, Peking cotoneaster, common chokecherry, silver buffaloberry.	Siberian elm, Siberian crabapple, green ash, ponderosa pine.	---	---
Exline.					
4 Rosewood	American plum	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar, Amur honeysuckle.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
6 Parnell	Siberian peashrub, American plum, redosier dogwood.	Black Hills spruce, common chokecherry, Siberian crabapple, lilac, eastern redcedar.	Green ash	Golden willow	Plains cottonwood.
7. Southam					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
8. Tonka	---	Eastern redcedar, common chokecherry, lilac, American plum, redosier dogwood, Siberian peashrub.	Green ash, Siberian crabapple, Black Hills spruce.	Golden willow	Eastern cottonwood.
9. Bearden	---	Redosier dogwood, ponderosa pine, eastern redcedar, common chokecherry, Siberian peashrub, Peking cotoneaster, American plum.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
10. Glyndon	Silver buffaloberry, Siberian peashrub.	---	Siberian elm, green ash, Russian olive.	---	---
12B. Arvilla	Silver buffaloberry, Siberian peashrub, lilac.	Green ash, Russian olive, Siberian crabapple, eastern redcedar, Rocky Mountain juniper, common chokecherry.	Ponderosa pine	---	---
13. Rosewood	American plum	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar, Amur honeysuckle.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
14*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---
Gardena	---	American plum, ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
15*, 15B*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---
Svea	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow	Eastern cottonwood.
16B*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---
Cresbard	Peking cotoneaster	Russian olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
17B*, 17C*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---
Buse	Siberian peashrub	Green ash, eastern redcedar, ponderosa pine, Russian olive, Rocky Mountain juniper.	Siberian elm	---	---
18B*:					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
18B*:					
Cavour-----------	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian olive, eastern redcedar.	---	---	---
19E*:					
Buse.					
Barnes.					
21*:					
Cavour-----------	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian olive, eastern redcedar.	---	---	---
Miranda.					
22---------------- Colvin	---	American plum, Siberian peashrub, common chokecherry, lilac, eastern redcedar, redosier dogwood.	Green ash, Black Hills spruce, Siberian crabapple.	Golden willow-----	Eastern cottonwood.
23---------------- Colvin	---	American plum, Siberian peashrub, eastern redcedar, redosier dogwood, lilac.	Green ash, Black Hills spruce, Siberian crabapple.	Golden willow-----	Eastern cottonwood, Siberian elm.
24---------------- Gardena	---	American plum, ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
25---------------- Divide	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
26B*:					
Eckman-----------	---	Eastern redcedar, American plum, lilac, redosier dogwood, Siberian peashrub.	Ponderosa pine, green ash, bur oak, Black Hills spruce, Russian olive, Siberian crabapple.	---	---
Gardena----------	---	American plum, ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, common chokecherry, Siberian peashrub.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
27B--------------- Embden	---	Peking cotoneaster, ponderosa pine, eastern redcedar, redosier dogwood, common chokecherry, Siberian peashrub, American plum.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.
28B--------------- Clontarf	---	Common chokecherry, Siberian peashrub, eastern redcedar, American plum, silver buffaloberry, Siberian crabapple, lilac.	Green ash, bur oak, ponderosa pine, Russian olive.	---	---
29---------------- Glyndon	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
31, 31B----------- Edgeley	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Bur oak, Siberian crabapple, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
33----------------- Hecla	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
34*:					
Hecla------------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
Hamar------------	American plum-----	Redosier dogwood, common chokecherry, Siberian peashrub, lilac.	Black Hills spruce, green ash, Siberian crabapple, eastern redcedar.	Golden willow-----	Eastern cottonwood.
35----------------- Fordville	Lilac, Siberian peashrub, silver buffaloberry.	Siberian crabapple, common chokecherry, green ash, eastern redcedar, Russian olive, Rocky Mountain juniper.	Ponderosa pine----	---	---
36*:					
Hecla------------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.
Ulen-------------	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
37*:					
Forman	---	Eastern redcedar, lilac, American plum, Siberian peashrub, redosier dogwood.	Bur oak, Siberian crabapple, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---
Cavour	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian olive, eastern redcedar.	---	---	---
38*:					
Miranda.					
Cavour	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian olive, eastern redcedar.	---	---	---
39 Hamar	American plum	Redosier dogwood, common chokecherry, Siberian peashrub, lilac.	Black Hills spruce, green ash, Siberian crabapple, eastern redcedar.	Golden willow	Eastern cottonwood.
40*:					
Hamerly	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
Tonka	---	Eastern redcedar, common chokecherry, lilac, American plum, redosier dogwood, Siberian peashrub.	Green ash, Siberian crabapple, Black Hills spruce.	Golden willow	Eastern cottonwood.
Parnell	American plum	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
41 Colvin	Silver buffaloberry, Siberian peashrub.	---	Russian olive, green ash, Siberian elm.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
42*: Hamerly	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
Wyard	---	Siberian peashrub, ponderosa pine, American plum, Peking cotoneaster, eastern redcedar, redosier dogwood, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
43. Exline					
44. Harriet					
46 Ludden	---	Eastern redcedar, lilac, redosier dogwood, Siberian peashrub, American plum, common chokecherry.	Siberian crabapple, green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
47. La Prairie					
48 La Prairie	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, Amur honeysuckle, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
49 Lamoure	American plum	Eastern redcedar, redosier dogwood, Siberian peashrub, lilac, common chokecherry.	Green ash, Black Hills spruce, Manchurian crabapple.	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
50*:					
Wyndmere	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, Amur honeysuckle, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
Tiffany	---	Lilac, redosier dogwood, eastern redcedar, American plum, common chokecherry, Siberian peashrub.	Siberian crabapple, green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
51*:					
Kratka	---	Common chokecherry, redosier dogwood, lilac, Siberian peashrub, eastern redcedar, American plum.	Siberian crabapple, Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
Letcher	Silver buffaloberry, Siberian peashrub, Rocky Mountain juniper.	Eastern redcedar, Russian olive, ponderosa pine, green ash, Siberian elm.	---	---	---
52C*:					
Brantford	Lilac, Siberian peashrub, silver buffaloberry.	Siberian crabapple, green ash, Russian olive, common chokecherry, eastern redcedar, Rocky Mountain juniper.	Ponderosa pine	---	---
Coe.					
53*:					
Brantford	Lilac, Siberian peashrub, silver buffaloberry.	Siberian crabapple, green ash, Russian olive, common chokecherry, eastern redcedar, Rocky Mountain juniper.	Ponderosa pine	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
53*:					
Vang	Lilac, Siberian peashrub, silver buffaloberry.	Siberian crabapple, green ash, Russian olive, common chokecherry, eastern redcedar, Rocky Mountain juniper.	Ponderosa pine	---	---
54 Maddock	---	Lilac, silver buffaloberry, common chokecherry, Siberian peashrub, eastern redcedar, Siberian crabapple, American plum.	Green ash, ponderosa pine, Russian olive, bur oak.	---	---
56 Overly	---	Siberian peashrub, ponderosa pine, Peking cotoneaster, redosier dogwood, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow	Eastern cottonwood.
57*:					
Ryan	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian olive, eastern redcedar.	---	---	---
Ludden	Silver buffaloberry, Siberian peashrub.	---	Russian olive, green ash, Siberian elm.	---	---
58 Renshaw	Silver buffaloberry, Siberian peashrub, lilac.	Green ash, eastern redcedar, Siberian crabapple, common chokecherry, Rocky Mountain juniper.	Ponderosa pine, Russian olive.	---	---
59*. Pits					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
60B*:					
Renshaw	Silver buffaloberry, Siberian peashrub, lilac.	Green ash, eastern redcedar, Siberian crabapple, common chokecherry, Rocky Mountain juniper.	Ponderosa pine, Russian olive.	---	---
Sioux.					
61D. Sioux					
62C*:					
Sioux.					
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---
64 Sinai	---	Eastern redcedar, Siberian peashrub, Russian olive, lilac, Peking cotoneaster, common chokecherry, silver buffaloberry.	Siberian elm, Siberian crabapple, green ash, ponderosa pine.	---	---
65B*:					
Serden	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
Hamar	American plum	Redosier dogwood, common chokecherry, Siberian peashrub, lilac.	Black Hills spruce, green ash, Siberian crabapple, eastern redcedar.	Golden willow	Eastern cottonwood.
66 Spottswood	---	Eastern redcedar, lilac, American plum, redosier dogwood, Siberian peashrub.	Ponderosa pine, Russian olive, green ash, bur oak, Black Hills spruce, Siberian crabapple.	---	---
67 Stirum	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian olive, eastern redcedar.	---	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
68*:					
Stirum	Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, green ash, ponderosa pine, Russian olive, eastern redcedar.	---	---	---
Letcher	Silver buffaloberry, Siberian peashrub, Rocky Mountain juniper.	Eastern redcedar, Russian olive, ponderosa pine, green ash, Siberian elm.	---	---	---
69 Letcher	Silver buffaloberry, Siberian peashrub, Rocky Mountain juniper.	Eastern redcedar, Russian olive, ponderosa pine, green ash, Siberian elm.	---	---	---
70 Svea	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow	Eastern cottonwood.
71*:					
Svea	---	Redosier dogwood, ponderosa pine, common chokecherry, Siberian peashrub, American plum.	Black Hills spruce, blue spruce, green ash, eastern redcedar.	Golden willow	Eastern cottonwood.
Cresbard	Peking cotoneaster	Russian olive, common chokecherry, eastern redcedar, silver buffaloberry, Siberian peashrub, lilac.	Green ash, ponderosa pine, Siberian elm, Siberian crabapple.	---	---
72 Swenoda	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
73*:					
Swenoda	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
Letcher	Silver buffaloberry, Siberian peashrub, Rocky Mountain juniper.	Eastern redcedar, Russian olive, ponderosa pine, green ash, Siberian elm.	---	---	---
74*:					
Swenoda	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
Barnes	---	Eastern redcedar, American plum, lilac, Siberian peashrub, redosier dogwood.	Siberian crabapple, bur oak, green ash, ponderosa pine, Black Hills spruce, Russian olive.	---	---
77 Towner	---	Lilac, eastern redcedar, Siberian peashrub, common chokecherry, Siberian crabapple, American plum, silver buffaloberry.	Ponderosa pine, green ash, Russian olive, bur oak.	---	---
78 Ulen	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
79*:					
Ulen	---	Common chokecherry, American plum, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, redosier dogwood.	Black Hills spruce, green ash.	Golden willow	Eastern cottonwood.
Hamar	American plum	Redosier dogwood, common chokecherry, Siberian peashrub, lilac.	Black Hills spruce, green ash, Siberian crabapple, eastern redcedar.	Golden willow	Eastern cottonwood.
80*, 81B*:					
Makoti	---	Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub, American plum.	Bur oak, Black Hills spruce, green ash, ponderosa pine, golden willow.	---	Plains cottonwood.
Sakakawea	Siberian peashrub, eastern redcedar.	Green ash, Russian olive, ponderosa pine, Rocky Mountain juniper.	Siberian elm	---	---
85B*:					
Lehr	---	Green ash, ponderosa pine, Russian olive, Siberian peashrub, eastern redcedar, Rocky Mountain juniper.	Siberian elm	---	---
Wabek.					
86E. Wabek					
90 Vallers	---	Redosier dogwood, eastern redcedar, American plum, lilac, common chokecherry, Siberian peashrub.	Black Hills spruce, Siberian crabapple, green ash.	Golden willow	Eastern cottonwood.
91B Ruso	---	Green ash, ponderosa pine, Russian olive, Siberian peashrub, eastern redcedar, Rocky Mountain juniper.	Siberian elm	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
92B*:					
Williams	---	Russian olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Bowbells	---	Siberian crabapple, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Golden willow, green ash, ponderosa pine, Black Hills spruce.	---	Plains cottonwood.
93C*:					
Williams	---	Russian olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Zahl	Eastern redcedar, Siberian peashrub.	Ponderosa pine, green ash, Russian olive, Rocky Mountain juniper.	Siberian elm	---	---
94C. Williams					
95B*:					
Bowbells	---	Siberian crabapple, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Golden willow, green ash, ponderosa pine, Black Hills spruce.	---	Plains cottonwood.
Zahl	Eastern redcedar, Siberian peashrub.	Ponderosa pine, green ash, Russian olive, Rocky Mountain juniper.	Siberian elm	---	---
96E*:					
Zahl.					
Williams.					
97F*:					
Zahl.					
Max.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
98D*:					
Williams	---	Russian olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Zahl	Eastern redcedar, Siberian peashrub.	Ponderosa pine, green ash, Russian olive, Rocky Mountain juniper.	Siberian elm	---	---
Parnell	Siberian peashrub, American plum, redosier dogwood.	Black Hills spruce, common chokecherry, Siberian crabapple, lilac, eastern redcedar.	Green ash	Golden willow	Plains cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
2*:				
Overly	Slight	Slight	Slight	Slight.
Aberdeen	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
3*:				
Aberdeen	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Exline	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
4 Rosewood	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
6 Parnell	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
7 Southam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
8 Tonka	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
9 Bearden	Moderate: wetness.	Moderate: wetness, percs slowly.	Moderate: wetness.	Slight.
10 Glyndon	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
12B Arvilla	Slight	Slight	Moderate: slope.	Slight.
13 Rosewood	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
14*:				
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight.
Gardena	Slight	Slight	Moderate: slope.	Slight.
15*, 15B*:				
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight.
Svea	Slight	Slight	Moderate: slope, small stones.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
16B*:				
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight.
Cresbard	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
17B*:				
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight.
Buse	Slight	Slight	Moderate: slope, small stones.	Slight.
17C*:				
Barnes	Slight	Slight	Severe: slope.	Slight.
Buse	Slight	Slight	Severe: slope.	Slight.
18B*:				
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight.
Cavour	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
19E*:				
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
21*:				
Cavour	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Miranda	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
22 Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
23 Colvin	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
24 Gardena	Slight	Slight	Slight	Slight.
25 Divide	Slight	Slight	Slight	Slight.
26B*:				
Eckman	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
26B*:				
Gardena	Slight	Slight	Moderate: slope.	Slight.
27B Embden	Slight	Slight	Moderate: slope.	Slight.
28B Clontarf	Slight	Slight	Moderate: slope.	Slight.
29 Glyndon	Slight	Slight	Slight	Slight.
31, 31B Edgeley	Slight	Slight	Moderate: slope, thin layer, area reclaim.	Slight.
33 Hecla	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
34*:				
Hecla	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Hamar	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
35 Fordville	Slight	Slight	Moderate: slope.	Slight.
36*:				
Hecla	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Ulen	Slight	Slight	Slight	Slight.
37*:				
Forman	Slight	Slight	Moderate: slope.	Slight.
Cavour	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
38*:				
Miranda	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Cavour	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
39 Hamar	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
40*:				
Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Tonka	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
40*:				
Parnell	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
41 Colvin	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness.
42*:				
Hamerly	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Wyard	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
43 Exline	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
44 Harriet	Severe: flooding, wetness, percs slowly.	Severe: wetness, excess sodium, percs slowly.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness.
46 Ludden	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.
47 La Prairie	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
48 La Prairie	Severe: flooding.	Slight	Slight	Slight.
49 Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
50*:				
Wyndmere	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight.
Tiffany	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
51*:				
Kratka	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Letcher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
52C*:				
Brantford	Slight	Slight	Severe: slope.	Slight.
Coe	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
53*:				
Brantford	Slight	Slight	Moderate: slope, small stones.	Slight.
Vang	Slight	Slight	Moderate: slope.	Slight.
54 Maddock	Slight	Slight	Moderate: slope.	Slight.
56 Overly	Slight	Slight	Slight	Slight.
57*:				
Ryan	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, excess sodium.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.
Ludden	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey, excess salt.	Severe: too clayey, wetness.	Severe: wetness, too clayey.
58 Renshaw	Slight	Slight	Slight	Slight.
59*. Pits				
60B*:				
Renshaw	Slight	Slight	Moderate: slope.	Slight.
Sioux	Slight	Slight	Moderate: slope, small stones.	Slight.
61D Sioux	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
62C*:				
Sioux	Slight	Slight	Severe: slope.	Slight.
Barnes	Slight	Slight	Severe: slope.	Slight.
64 Sinai	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
65B*:				
Serden	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Hamar	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
66 Spottswood	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
67 Stirum	Severe: wetness, excess sodium.	Severe: excess sodium.	Severe: wetness, excess sodium.	Moderate: wetness.
68*:				
Stirum	Severe: wetness, excess sodium.	Severe: excess sodium.	Severe: wetness, excess sodium.	Moderate: wetness.
Letcher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
69 Letcher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
70 Svea	Slight	Slight	Moderate: small stones.	Slight.
71*:				
Svea	Slight	Slight	Moderate: small stones.	Slight.
Cresbard	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
72 Swenoda	Slight	Slight	Moderate: slope.	Slight.
73*:				
Swenoda	Slight	Slight	Moderate: slope.	Slight.
Letcher	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
74*:				
Swenoda	Slight	Slight	Moderate: slope.	Slight.
Barnes	Slight	Slight	Moderate: slope, small stones.	Slight.
77 Towner	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
78 Ulen	Slight	Slight	Slight	Slight.
79*:				
Ulen	Slight	Slight	Slight	Slight.
Hamar	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
80*, 81B*:				
Makoti	Slight	Slight	Moderate: slope.	Slight.
Sakakawea	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
85B*:				
Lehr	Slight	Slight	Moderate: slope.	Slight.
Wabek	Slight	Slight	Moderate: slope.	Slight.
86E Wabek	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
90 Vallers	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
91B Ruso	Slight	Slight	Moderate: slope.	Slight.
92B*:				
Williams	Slight	Slight	Moderate: slope.	Slight.
Bowbells	Slight	Slight	Moderate: slope.	Slight.
93C*:				
Williams	Slight	Slight	Severe: slope.	Slight.
Zahl	Slight	Slight	Severe: slope.	Slight.
94C Williams	Slight	Slight	Severe: large stones, slope.	Slight.
95B*:				
Bowbells	Slight	Slight	Moderate: slope.	Slight.
Zahl	Slight	Slight	Moderate: slope.	Slight.
96E*:				
Zahl	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Williams	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
97F*:				
Zahl	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Max	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
98D*:				
Williams	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
98D*:				
Zahl	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Parnell	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
2*:									
Overly	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Aberdeen	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Fair.
3*:									
Aberdeen	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Fair.
Exline	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Poor	Fair.
4 Rosewood	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
6 Parnell	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
7 Southam	Very poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Good	Very poor.
8 Tonka	Poor	Fair	Fair	Poor	Good	Good	Poor	Good	Poor.
9 Bearden	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
10 Glyndon	Fair	Fair	Good	Fair	Poor	Poor	Fair	Poor	Fair.
12B Arvilla	Fair	Good	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
13 Rosewood	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
14*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Gardena	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
15*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Svea	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
15B*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Svea	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
16B*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cresbard	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Very poor	Good.
17B*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
17B*:									
Buse	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
17C*:									
Barnes	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Buse	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
18B*:									
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cavour	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
19E*:									
Buse	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Barnes	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
21*:									
Cavour	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Miranda	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor.
22 Colvin	Poor	Fair	Fair	Fair	Good	Good	Poor	Good	Fair.
23 Colvin	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
24 Gardena	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
25 Divide	Fair	Fair	Good	Fair	Fair	Very poor	Fair	Poor	Fair.
26B*:									
Eckman	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Gardena	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
27B Embden	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
28B Clontarf	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
29 Glyndon	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
31, 31B Edgeley	Good	Good	Good	Fair	Poor	Poor	Good	Very poor	Fair.
33 Hecla	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
34*:									
Hecla	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Hamar	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
35------------------ Fordville	Good	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
36*:									
Hecla---------------	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Ulen----------------	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
37*:									
Forman--------------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cavour--------------	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
38*:									
Miranda-------------	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor.
Cavour--------------	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
39------------------ Hamar	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
40*:									
Hamerly-------------	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Tonka---------------	Poor	Fair	Fair	Poor	Good	Good	Poor	Good	Poor.
Parnell-------------	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
41------------------ Colvin	Poor	Fair	Poor	Fair	Good	Good	Poor	Good	Poor.
42*:									
Hamerly-------------	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Wyard---------------	Good	Good	Good	Good	Fair	Fair	Good	Fair	Good.
43------------------ Exline	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Poor	Fair.
44------------------ Harriet	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
46------------------ Ludden	Fair	Fair	Good	Good	Poor	Good	Fair	Fair	Good.
47------------------ La Prairie	Very poor	Poor	Fair	Good	Good	Poor	Poor	Poor	Fair.
48------------------ La Prairie	Good	Good	Fair	---	Very poor	Very poor	Good	Very poor	Fair.
49------------------ Lamoure	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
50*:									
Wyndmere------------	Fair	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
Tiffany-------------	Poor	Fair	Good	Fair	Good	Fair	Fair	Fair	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
51*:									
Kratka	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Letcher	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
52C*:									
Brantford	Fair	Fair	Good	Poor	Poor	Very poor	Fair	Very poor	Fair.
Coe	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Fair.
53*:									
Brantford	Fair	Fair	Good	Poor	Poor	Poor	Fair	Very poor	Fair.
Vang	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
54 Maddock	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
56 Overly	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
57*:									
Ryan	Poor	Poor	Poor	Very poor	Poor	Good	Poor	Fair	Very poor.
Ludden	Fair	Fair	Very poor	Very poor	Good	Good	Fair	Good	Very poor.
58 Renshaw	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
59*. Pits									
60B*:									
Renshaw	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
61D Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
62C*:									
Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Barnes	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
64 Sinai	Good	Good	Fair	Poor	Poor	Poor	Good	Poor	Poor.
65B*:									
Serden	Poor	Fair	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.
Hamar	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
66 Spottswood	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
67 Stirum	Very poor	Very poor	Very poor	Fair	Good	Fair	Very poor	Fair	Poor.
68*:									
Stirum	Very poor	Very poor	Very poor	Fair	Good	Fair	Very poor	Fair	Poor.
Letcher	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
69 Letcher	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
70 Svea	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
71*:									
Svea	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Cresbard	Good	Fair	Good	Poor	Very poor	Very poor	Good	Very poor	Good.
72 Swenoda	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
73*:									
Swenoda	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Letcher	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor.
74*:									
Swenoda	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Barnes	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
77 Towner	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
78 Ulen	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
79*:									
Ulen	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Hamar	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
80*:									
Makoti	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Fair.
Sakakawea	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
81B*:									
Makoti	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.
Sakakawea	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
85B*:									
Lehr	Fair	Good	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
Wabek	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
86E----------------- Wabek	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
90----------------- Vallers	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
91B----------------- Ruso	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
92B*:									
Williams-----------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Bowbells-----------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
93C*:									
Williams-----------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Zahl---------------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
94C----------------- Williams	Poor	Poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
95B*:									
Bowbells-----------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Zahl---------------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
96E*:									
Zahl---------------	Very poor	Very poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Williams-----------	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
97F*:									
Zahl---------------	Very poor	Very poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Max----------------	Very poor	Very poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
98D*:									
Williams-----------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Zahl---------------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Parnell------------	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
2*:					
Overly-----------	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.
Aberdeen---------	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
3*:					
Aberdeen---------	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Exline-----------	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
4---------------- Rosewood	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.
6---------------- Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
7---------------- Southam	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
8---------------- Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
9---------------- Bearden	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.
10--------------- Glyndon	Severe: cutbanks cave.	Slight-----------	Moderate: wetness.	Slight------------	Severe: frost action.
12B-------------- Arvilla	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
13--------------- Rosewood	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.
14*:					
Barnes-----------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
14*:					
Gardena----------	Moderate: wetness.	Slight----------	Moderate: wetness.	Slight------------	Severe: frost action.
15*:					
Barnes-----------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.
Svea-------------	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength.
15B*:					
Barnes-----------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.
Svea-------------	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope.	Severe: low strength.
16B*:					
Barnes-----------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.
Cresbard---------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
17B*, 17C*:					
Barnes-----------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.
Buse-------------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
18B*:					
Barnes-----------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.
Cavour-----------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: shrink-swell, wetness.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
19E*:					
Buse-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Barnes-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
21*:					
Cavour-----------	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
21*:					
Miranda	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
22 Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.
23 Colvin	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.
24 Gardena	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.
25 Divide	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
26B*:					
Eckman	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.
Gardena	Moderate: wetness.	Slight	Moderate: wetness.	Moderate: slope.	Severe: frost action.
27B Embden	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
28B Clontarf	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
29 Glyndon	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Severe: frost action.
31 Edgeley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
31B Edgeley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
33 Hecla	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
34*:					
Hecla	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
Hamar	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
35 Fordville	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
36*:					
Hecla	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
36*:					
Ulen	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
37*:					
Forman	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.
Cavour	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
38*:					
Miranda	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Cavour	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
39 Hamar	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
40*:					
Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
Parnell	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.
41 Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.
42*:					
Hamerly	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
Wyard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.
43 Exline	Severe: cutbanks cave.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
44 Harriet	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
46 Ludden	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
47 La Prairie	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, low strength.
48 La Prairie	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, low strength, flooding.
49 Lamoure	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.
50*:					
Wyndmere	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.
Tiffany	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.
51*:					
Kratka	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Letcher	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
52C*:					
Brantford	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Coe	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
53*:					
Brantford	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Vang	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
54 Maddock	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
56 Overly	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
57*:					
Ryan	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
Ludden	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
58 Renshaw	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
59*. Pits					
60B*:					
Renshaw	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Sioux	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
61D Sioux	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
62C*:					
Sioux	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Barnes	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.
64 Sinai	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
65B*:					
Serden	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Hamar	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
66 Spottswood	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength.
67 Stirum	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.
68*:					
Stirum	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.
Letcher	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Moderate: frost action.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
69 Letcher	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
70 Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength.
71*:					
Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength.
Cresbard	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
72 Swenoda	Moderate: wetness.	Slight	Moderate: wetness, shrink-swell.	Slight	Moderate: frost action.
73*:					
Swenoda	Moderate: wetness.	Slight	Moderate: wetness, shrink-swell.	Slight	Moderate: frost action.
Letcher	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
74*:					
Swenoda	Moderate: wetness.	Slight	Moderate: wetness, shrink-swell.	Slight	Moderate: frost action.
Barnes	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.
77 Towner	Severe: cutbanks cave.	Slight	Moderate: wetness, shrink-swell.	Slight	Moderate: frost action.
78 Ulen	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
79*:					
Ulen	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.
Hamar	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
80*:					
Makoti	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Sakakawea	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
81B*:					
Makoti-----------	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Sakakawea--------	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
85B*:					
Lehr-------------	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
Wabek------------	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
86E--------------- Wabek	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
90---------------- Vallers	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.
91B--------------- Ruso	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
92B*:					
Williams---------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Bowbells---------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
93C*:					
Williams---------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Zahl-------------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
94C--------------- Williams	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
95B*:					
Bowbells---------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Zahl-------------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
96E*:					
Zahl-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
96E*:					
Williams----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
97F*:					
Zahl--------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Max---------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
98D*:					
Williams----------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Zahl--------------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Parnell-----------	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2*:					
Overly	Severe: percs slowly.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Poor: thin layer.
Aberdeen	Severe: percs slowly.	Moderate: seepage.	Severe: wetness, too clayey, too sandy.	Moderate: wetness.	Poor: too clayey, excess sodium.
3*:					
Aberdeen	Severe: percs slowly.	Moderate: seepage.	Severe: wetness, too clayey, too sandy.	Moderate: wetness.	Poor: too clayey, excess sodium.
Exline	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey, too sandy.	Severe: wetness.	Poor: too clayey, hard to pack, excess sodium.
4 Rosewood	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
6 Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
7 Southam	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
8 Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
9 Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
10 Glyndon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
12B Arvilla	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13: Rosewood	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
14*:					
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Gardena	Moderate: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Good.
15*, 15B*:					
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Svea	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
16B*:					
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Cresbard	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
17B*:					
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Buse	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
17C*:					
Barnes	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Buse	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
18B*:					
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Cavour	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium, wetness.	Moderate: wetness.	Poor: hard to pack, excess sodium.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
19E*:					
Buse	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Barnes	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
21*:					
Cavour	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight	Poor: hard to pack, excess sodium.
Miranda	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight	Poor: excess sodium.
22 Colvin	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
23 Colvin	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
24 Gardena	Moderate: wetness.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Good.
25 Divide	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
26B*:					
Eckman	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Gardena	Moderate: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Good.
27B Embden	Moderate: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Fair: too sandy.
28B Clontarf	----	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
29 Glyndon	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
31, 31B Edgeley	Severe: thin layer, seepage.	Severe: seepage.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
33------------------ Hecla	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, seepage.
34*:					
Hecla--------------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, seepage.
Hamar--------------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
35------------------ Fordville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
36*:					
Hecla--------------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, seepage.
Ulen---------------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
37*:					
Forman-------------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Cavour-------------	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight-----------	Poor: hard to pack, excess sodium.
38*:					
Miranda------------	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight-----------	Poor: excess sodium.
Cavour-------------	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight-----------	Poor: hard to pack, excess sodium.
39------------------ Hamar	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
40*:					
Hamerly------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
40*:					
Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
41 Colvin	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Severe: wetness.	Poor: wetness.
42*:					
Hamerly	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Wyard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
43 Exline	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey, too sandy.	Severe: wetness.	Poor: too clayey, hard to pack, excess sodium.
44 Harriet	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: hard to pack, wetness, excess sodium.
46 Ludden	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, wetness.
47 La Prairie	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Good.
48 La Prairie	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
49 Lamoure	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
50*:					
Wyndmere	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy.
Tiffany	Severe: ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
51*:					
Kratka	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
Letcher	Severe: wetness.	Severe: seepage.	Severe: seepage, excess sodium.	Severe: seepage.	Poor: excess sodium.
52C*:					
Brantford	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Coe	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
53*:					
Brantford	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Vang	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
54 Maddock	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
56 Overly	Severe: percs slowly.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Poor: thin layer.
57*:					
Ryan	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Ludden	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
58 Renshaw	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
59*. Pits					
60B*:					
Renshaw	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
60B*:					
Sioux	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
61D Sioux	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
62C*:					
Sioux	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
64 Sinai	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
65B*:					
Serden	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Hamar	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
66 Spottswood	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
67 Stirum	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, excess sodium.	Severe: seepage, wetness.	Poor: wetness, excess sodium.
68*:					
Stirum	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, excess sodium.	Severe: seepage, wetness.	Poor: wetness, excess sodium.
Letcher	Severe: wetness.	Severe: seepage.	Severe: seepage, excess sodium.	Severe: seepage.	Poor: excess sodium.
69 Letcher	Severe: wetness.	Severe: seepage.	Severe: seepage, excess sodium.	Severe: seepage.	Poor: excess sodium.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
70: Svea	Severe: percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
71*:					
Svea	Severe: percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Cresbard	Severe: percs slowly.	Moderate: wetness.	Severe: wetness, excess sodium.	Moderate: wetness.	Poor: hard to pack, excess sodium.
72: Swenoda	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
73*:					
Swenoda	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
Letcher	Severe: wetness.	Severe: seepage.	Severe: seepage, excess sodium.	Severe: seepage.	Poor: excess sodium.
74*:					
Swenoda	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
Barnes	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
77: Towner	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
78: Ulen	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
79*:					
Ulen	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Hamar	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
80*, 81B*:					
Makoti	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
80*, 81B*:					
Sakakawea----------	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Fair: thin layer.
85B*:					
Lehr---------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Wabek--------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
86E----------------- Wabek	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
90------------------ Vallers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
91B----------------- Ruso	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
92B*:					
Williams-----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Bowbells-----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
93C*:					
Williams-----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Zahl---------------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
94C----------------- Williams	Severe: percs slowly.	Moderate: seepage, slope, large stones.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
95B*:					
Bowbells-----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Zahl---------------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
96E*:					
Zahl	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Williams	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
97F*:					
Zahl	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Max	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
98D*:					
Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Zahl	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Parnell	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
2*:				
Overly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Aberdeen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
3*:				
Aberdeen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
Exline	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
4 Rosewood	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
6 Parnell	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
7 Southam	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
8 Tonka	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
9 Bearden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
10 Glyndon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
12B Arvilla	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
13 Rosewood	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
14*:				
Barnes	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
14*:				
Gardena	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
15*, 15B*:				
Barnes	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
16B*:				
Barnes	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Cresbard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
17B*, 17C*:				
Barnes	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Buse	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
18B*:				
Barnes	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
19E*:				
Buse	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Barnes	Fair: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
21*:				
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Miranda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
22, 23 Colvin	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
24 Gardena	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
25 Divide	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
26B*:				
Eckman	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Gardena	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
27B Embden	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
28B Clontarf	Good	Probable	Improbable: too sandy.	Fair: thin layer.
29 Glyndon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
31, 31B Edgeley	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
33 Hecla	Good	Probable	Improbable: too sandy.	Poor: too sandy.
34*:				
Hecla	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Hamar	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
35 Fordville	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
36*:				
Hecla	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Ulen	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
37*:				
Forman	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
37*:				
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
38*:				
Miranda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Cavour	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
39 Hamar	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
40*:				
Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Tonka	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Parnell	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
41 Colvin	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
42*:				
Hamerly	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Wyard	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
43 Exline	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
44 Harriet	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess salt, thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
46: Ludden	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
47: La Prairie	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
48: La Prairie	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
49: Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
50*:				
Wyndmere	Fair: thin layer, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Tiffany	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
51*:				
Kratka	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Letcher	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
52C*:				
Brantford	Good	Probable	Probable	Poor: small stones, area reclaim.
Coe	Good	Probable	Probable	Poor: small stones, area reclaim.
53*:				
Brantford	Good	Probable	Probable	Poor: small stones, area reclaim.
Vang	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
54: Maddock	Good	Probable	Improbable: too sandy.	Poor: too sandy.
56: Overly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
57*:				
Ryan	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Ludden	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
58 Renshaw	Good	Probable	Probable	Poor: small stones, area reclaim.
59*. Pits				
60B*:				
Renshaw	Good	Probable	Probable	Poor: small stones, area reclaim.
Sioux	Good	Probable	Probable	Poor: small stones, area reclaim.
61D Sioux	Good	Probable	Probable	Poor: small stones, area reclaim.
62C*:				
Sioux	Good	Probable	Probable	Poor: small stones, area reclaim.
Barnes	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
64 Sinai	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
65B*:				
Serden	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Hamar	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
66 Spottswood	Good	Probable	Probable	Poor: small stones, area reclaim.
67 Stirum	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
68*:				
Stirum	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
Letcher	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
69 Letcher	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
70 Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
71*:				
Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Cresbard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
72 Swenoda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
73*:				
Swenoda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Letcher	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
74*:				
Swenoda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Barnes	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
77 Towner	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
78 Ulen	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
79*:				
Ulen	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Hamar	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
80*, 81B*:				
Makoti	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sakakawea	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
85B*:				
Lehr	Good	Probable	Probable	Poor: small stones, area reclaim.
Wabek	Good	Probable	Probable	Poor: small stones, area reclaim.
86E Wabek	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
90 Vallers	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
91B Ruso	Good	Probable	Probable	Poor: small stones, area reclaim.
92B*:				
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Bowbells	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
93C*:				
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Zahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
94C Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, large stones.
95B*:				
Bowbells	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Zahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
96E*:				
Zahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
97F*:				
Zahl	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
97F*:				
Max------------------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
98D*:				
Williams-------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Zahl-----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Parnell--------------	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
2*:						
Overly	Slight	Severe: piping.	Deep to water	Percs slowly	Favorable	Percs slowly.
Aberdeen	Moderate: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
3*:						
Aberdeen	Moderate: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
Exline	Slight	Severe: excess sodium.	Percs slowly, cutbanks cave, excess salt.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Excess sodium, erodes easily, percs slowly.
4 Rosewood	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
6 Parnell	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
7 Southam	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, excess salt, erodes easily.
8 Tonka	Slight	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
9 Bearden	Moderate: seepage.	Moderate: piping, hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
10 Glyndon	Severe: seepage.	Severe: piping.	Frost action, cutbanks cave, excess salt.	Wetness, excess salt.	Wetness	Excess salt.
12B Arvilla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Too sandy.	Droughty.
13 Rosewood	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, frost action, cutbanks cave.	Ponding, droughty.	Ponding, too sandy, soil blowing.	Wetness, droughty.
14*:						
Barnes	Slight	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
14*:						
Gardena	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
15*:						
Barnes	Slight	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Svea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
15B*:						
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Svea	Moderate: slope, seepage.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
16B*:						
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Cresbard	Moderate: slope.	Severe: excess sodium, hard to pack.	Deep to water	Slope, percs slowly, excess sodium.	Favorable	Excess sodium, percs slowly.
17B*, 17C*:						
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Buse	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
18B*:						
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Cavour	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, rooting depth.
19E*:						
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
21*:						
Cavour	Slight	Severe: excess sodium.	Deep to water	Excess sodium, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily, rooting depth.
Miranda	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Percs slowly	Excess sodium, percs slowly.
22 Colvin	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
23----------------Colvin	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
24----------------Gardena	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
25----------------Divide	Severe: seepage.	Severe: seepage.	Cutbanks cave	Wetness--------	Wetness, too sandy.	Favorable.
26B*:						
Eckman-----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Gardena----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
27B---------------Embden	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
28B---------------Clontarf	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
29----------------Glyndon	Severe: seepage.	Severe: piping.	Frost action, cutbanks cave.	Wetness--------	Wetness--------	Favorable.
31----------------Edgeley	Moderate: seepage.	Severe: thin layer.	Deep to water	Thin layer-----	Area reclaim---	Area reclaim.
31B---------------Edgeley	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope, thin layer.	Area reclaim---	Area reclaim.
33----------------Hecla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
34*:						
Hecla------------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Hamar------------	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
35----------------Fordville	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth	Too sandy------	Rooting depth.
36*:						
Hecla------------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
36*:						
Ulen	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
37*:						
Forman	Slight	Severe: piping.	Deep to water	Percs slowly	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Cavour	Slight	Severe: excess sodium.	Deep to water	Excess sodium, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily, rooting depth.
38*:						
Miranda	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Percs slowly	Excess sodium, percs slowly.
Cavour	Slight	Severe: excess sodium.	Deep to water	Excess sodium, percs slowly.	Erodes easily, percs slowly.	Excess sodium, erodes easily, rooting depth.
39 Hamar	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
40*:						
Hamerly	Slight	Severe: piping.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
Tonka	Slight	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Parnell	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
41 Colvin	Moderate: seepage.	Severe: wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, excess salt, percs slowly.
42*:						
Hamerly	Slight	Severe: piping.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
Wyard	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Erodes easily, wetness.	Wetness, erodes easily.
43 Exline	Slight	Severe: excess sodium.	Percs slowly, cutbanks cave, excess salt.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Excess sodium, erodes easily, percs slowly.
44 Harriet	Slight	Severe: piping, wetness, excess sodium.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, excess sodium.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
46----------------- Ludden	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
47----------------- La Prairie	Moderate: seepage.	Severe: piping.	Deep to water	Flooding--------	Favorable------	Favorable.
48----------------- La Prairie	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
49----------------- Lamoure	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness---------	Wetness.
50*:						
Wyndmere----------	Severe: seepage.	Severe: piping.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy, soil blowing.	Favorable.
Tiffany-----------	Severe: seepage.	Severe: piping, ponding.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
51*:						
Kratka------------	Severe: seepage.	Severe: piping, wetness.	Favorable------	Wetness, droughty, soil blowing.	Wetness, soil blowing.	Wetness, droughty, rooting depth.
Letcher-----------	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Soil blowing---	Excess sodium, percs slowly.
52C*:						
Brantford---------	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, rooting depth.	Large stones, too sandy.	Large stones, droughty.
Coe---------------	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty.	Slope, droughty.	Large stones, droughty.
53*:						
Brantford---------	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, rooting depth.	Large stones, too sandy.	Large stones, droughty.
Vang--------------	Severe: seepage.	Severe: seepage.	Deep to water	Favorable------	Too sandy------	Favorable.
54----------------- Maddock	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
56----------------- Overly	Slight---------	Severe: piping.	Deep to water	Percs slowly---	Favorable------	Percs slowly.
57*:						
Ryan--------------	Slight---------	Severe: hard to pack, wetness, excess sodium.	Percs slowly, flooding, excess salt.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, excess sodium, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
57*:						
Ludden	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, excess salt, droughty.
58 Renshaw	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Too sandy	Droughty.
59*. Pits						
60B*:						
Renshaw	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
Sioux	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
61D Sioux	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, too sandy.	Droughty, slope.
62C*:						
Sioux	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
Barnes	Moderate: slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
64 Sinai	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
65B*:						
Serden	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Hamar	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
66 Spottswood	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
67 Stirum	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave, excess salt, excess sodium.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, excess salt, excess sodium.
68*:						
Stirum	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave, excess salt, excess sodium.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, excess salt, excess sodium.
Letcher	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Soil blowing	Excess sodium, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
69----------------- Letcher	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Soil blowing---	Excess sodium, percs slowly.
70----------------- Svea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
71*:						
Svea--------------	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Cresbard----------	Slight----------	Severe: excess sodium, hard to pack.	Deep to water	Percs slowly, excess sodium.	Favorable------	Excess sodium, percs slowly.
72----------------- Swenoda	Severe: seepage.	Severe: piping.	Favorable------	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
73*:						
Swenoda-----------	Severe: seepage.	Severe: piping.	Favorable------	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
Letcher-----------	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Percs slowly, excess sodium.	Soil blowing---	Excess sodium, percs slowly.
74*:						
Swenoda-----------	Severe: seepage.	Severe: piping.	Favorable------	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
Barnes------------	Slight----------	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
77----------------- Towner	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake.	Erodes easily, soil blowing.	Erodes easily, droughty.
78----------------- Ulen	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
79*:						
Ulen--------------	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
Hamar-------------	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
80*:						
Makoti------------	Slight----------	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Sakakawea---------	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
81B*:						
Makoti------------	Moderate: slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
81B*:						
Sakakawea	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
85B*:						
Lehr	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
Wabek	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
86E Wabek	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, too sandy.	Slope, droughty.
90 Vallers	Slight	Severe: piping, wetness.	Frost action	Wetness	Wetness	Wetness.
91B Ruso	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
92B*:						
Williams	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Bowbells	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
93C*:						
Williams	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Zahl	Moderate: slope.	Severe: piping.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
94C Williams	Moderate: seepage, slope.	Moderate: piping, large stones.	Deep to water	Slope, percs slowly.	Large stones, percs slowly.	Large stones, percs slowly.
95B*:						
Bowbells	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Zahl	Moderate: slope.	Severe: piping.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
96E*:						
Zahl	Severe: slope.	Severe: piping.	Deep to water	Slope, percs slowly.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Williams	Severe: slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
97F*:						
Zahl	Severe: slope.	Severe: piping.	Deep to water	Slope, percs slowly.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Max	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
98D*:						
Williams	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Zahl	Severe: slope.	Severe: piping.	Deep to water	Slope, percs slowly.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Parnell	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
2*:											
Overly----------	0-8	Silt loam--------	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	85-100	25-45	5-25
	8-42	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
	42-60	Stratified silt loam to silty clay.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
Aberdeen--------	0-13	Silt loam, loam	CL, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-45	7-20
	13-27	Silty clay, clay, silty clay loam.	ML, MH	A-7	0	100	100	95-100	90-100	45-75	15-40
	27-60	Silty clay loam, silt loam.	CL, CH, MH, ML	A-6, A-7	0	100	100	95-100	90-100	35-55	15-25
3*:											
Aberdeen--------	0-13	Silt loam, loam	CL, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-45	7-20
	13-27	Silty clay, clay, silty clay loam.	ML, MH	A-7	0	100	100	95-100	90-100	45-75	15-40
	27-60	Silty clay loam, silt loam.	CL, CH, MH, ML	A-6, A-7	0	100	100	95-100	90-100	35-55	15-25
Exline----------	0-8	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-20
	8-21	Clay, silty clay, silty clay loam.	MH, CH	A-7	0	100	100	95-100	90-100	60-90	30-50
	21-60	Silty clay loam, silty clay, clay.	CH, MH	A-7	0	100	100	95-100	85-100	50-80	20-45
4---------------- Rosewood	0-9	Fine sandy loam	SM, SC, SM-SC	A-2, A-4	0	100	97-100	65-90	30-50	<30	NP-10
	9-26	Fine sandy loam, loamy fine sand, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	100	95-100	60-85	25-45	<30	NP-10
	26-60	Fine sand, sand	SM, SP-SM	A-1, A-2, A-3	0	85-100	75-95	45-75	5-25	---	NP
6---------------- Parnell	0-11	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	11-26	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-80	20-50
	26-60	Clay loam, clay, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
7---------------- Southam	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	85-100	25-40	5-15
	8-24	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	100	95-100	90-100	85-100	40-75	15-50
	24-60	Clay, silty clay loam, clay loam.	CL, CH, CL-ML	A-6, A-7, A-4	0	100	95-100	85-100	60-100	20-75	5-50

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
8----------------Tonka	0-18	Silt loam--------	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-35	5-15
	18-43	Silty clay loam, silty clay, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	43-60	Silty clay loam, clay loam, loam.	CL, CL-ML	A-6, A-7, A-4	0-3	90-100	85-100	60-100	50-90	25-50	5-30
9----------------Bearden	0-13	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	20-40	5-20
	13-36	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	90-100	80-95	25-55	10-30
	36-60	Silt loam, silty clay loam, loam.	CL, CH	A-6, A-7	0	100	100	90-100	80-95	25-55	10-30
10---------------Glyndon	0-9	Silt loam--------	ML	A-4	0	100	100	95-100	70-95	20-40	NP-10
	9-21	Silt loam, very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	80-95	20-30	NP-10
	21-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	85-100	50-90	10-30	NP-10
12B--------------Arvilla	0-9	Fine sandy loam	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	9-19	Sandy loam, loam, fine sandy loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	19-60	Gravelly coarse sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0	35-100	25-100	10-60	0-10	---	NP
13---------------Rosewood	0-9	Fine sandy loam	SM, SC, SM-SC	A-2, A-4	0	100	95-100	65-90	30-50	<30	NP-10
	9-26	Fine sandy loam, loamy fine sand, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	100	95-100	60-85	25-45	<30	NP-10
	26-60	Fine sand, sand	SM, SP-SM	A-1, A-2, A-3	0	85-100	75-95	45-75	5-25	---	NP
14*:											
Barnes----------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Gardena---------	0-12	Loam-------------	ML, CL-ML, CL	A-4, A-6	0	100	100	75-100	60-100	25-40	NP-15
	12-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	75-100	55-100	20-40	NP-15
15*, 15B*:											
Barnes----------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Svea------------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-29	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	29-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
16B*:											
Barnes----------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-40	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	40-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Cresbard--------	0-12	Loam-------------	ML, CL	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	12-24	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	65-85	40-60	15-30
	24-34	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	85-100	65-85	40-60	15-30
	34-60	Clay loam, loam	CL, CH, ML, MH	A-6, A-7	0-5	95-100	90-100	85-100	60-80	35-55	10-27
17B*, 17C*:											
Barnes----------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Buse------------	0-6	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	6-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
18B*:											
Barnes----------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-40	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	40-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Cavour----------	0-12	Loam-------------	ML, MH	A-4, A-6, A-7	0	100	90-100	85-100	60-85	30-55	5-20
	12-31	Clay, clay loam, silty clay loam.	CL, CH, MH, ML	A-7, A-6	0	100	90-100	90-100	55-85	35-65	15-30
	31-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	90-100	75-100	50-85	35-65	12-35
19E*:											
Buse------------	0-6	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	6-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
Barnes----------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
21*:											
Cavour----------	0-12	Loam-------------	ML, MH	A-4, A-6, A-7	0	100	90-100	85-100	60-85	30-55	5-20
	12-19	Clay, clay loam, silty clay loam.	CL, CH, MH, ML	A-7, A-6	0	100	90-100	90-100	55-85	35-65	15-30
	19-31	Clay loam, clay, loam.	CL, CH	A-7, A-6	0	95-100	90-100	85-100	60-85	35-65	15-35
	31-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	90-100	75-100	50-85	35-65	12-35
Miranda---------	0-4	Loam-------------	CL-ML, CL, ML	A-4, A-6	0	100	100	85-95	60-85	25-40	5-15
	4-27	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	50-80	30-50	10-30
	27-60	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	50-80	25-50	10-35

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
22, 23----------- Colvin	0-21	Silt loam--------	CL	A-6	0	100	100	90-100	80-95	25-40	10-20
	21-36	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	10-30
	36-60	Loam, silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
24--------------- Gardena	0-12	Loam-------------	ML, CL-ML, CL	A-4, A-6	0	100	100	75-100	60-100	25-40	NP-15
	12-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	75-100	55-100	20-40	NP-15
25--------------- Divide	0-13	Loam-------------	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-85	25-40	5-20
	13-28	Loam, clay loam, gravelly loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-7	0-3	95-100	75-100	55-90	35-80	20-45	5-20
	28-60	Stratified sand to very gravelly coarse sand.	GM, SM, GP-GM, SP-SM	A-1, A-3	0-5	25-95	15-90	10-70	5-25	<30	NP-5
26B*: Eckman----------	0-7	Silt loam--------	ML	A-4	0	100	100	85-100	60-90	20-40	NP-10
	7-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	85-100	55-90	20-40	NP-10
	35-60	Silt loam, very fine sandy loam, fine sandy loam.	ML, SM	A-4	0	100	100	65-100	40-90	<40	NP-10
Gardena---------	0-12	Silt loam--------	ML, CL-ML, CL	A-4, A-6	0	100	100	75-100	60-100	25-40	NP-15
	12-60	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4, A-6	0	100	100	75-100	55-100	20-40	NP-15
27B-------------- Embden	0-10	Sandy loam-------	SM, ML	A-2, A-4	0	100	100	60-95	30-75	<35	NP-10
	10-20	Fine sandy loam, sandy loam, very fine sandy loam.	SM, ML	A-2, A-4	0	100	100	60-100	25-55	---	NP
	20-60	Fine sandy loam, sandy loam, loamy fine sand.	SM	A-2, A-4	0	100	100	50-100	15-50	---	NP
28B-------------- Clontarf	0-8	Fine sandy loam	SM	A-2, A-4	0	100	95-100	60-85	25-50	<30	NP-7
	8-28	Sandy loam, loam, fine sandy loam.	SM, ML	A-2, A-4	0	100	95-100	60-95	20-60	<30	NP-7
	28-60	Loamy fine sand, fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	95-100	50-80	5-35	<20	NP
29--------------- Glyndon	0-9	Silt loam--------	ML	A-4	0	100	100	95-100	70-95	20-40	NP-10
	9-21	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	80-95	20-30	NP-10
	21-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML, SM, SC, CL	A-4, A-6	0	100	100	85-100	35-75	10-35	NP-15
31, 31B---------- Edgeley	0-6	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	20-40	5-25
	6-34	Clay loam, loam, channery loam.	CL, CH, MH	A-6, A-7	0-5	80-100	75-100	65-95	55-95	25-65	10-40
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
33----------------Hecla	0-9	Loamy fine sand	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	9-38	Loamy sand, loamy fine sand, fine sand.	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	38-60	Loamy sand, fine sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	10-35	<25	NP-7
34*:											
Hecla-----------	0-9	Loamy fine sand	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	9-38	Loamy sand, loamy fine sand, fine sand.	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	38-60	Loamy sand, fine sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	10-35	<25	NP-7
Hamar-----------	0-12	Loamy fine sand	SM, SM-SC	A-2, A-4	0	100	100	85-100	15-40	<25	NP-5
	12-60	Fine sand, loamy sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	100	70-100	10-35	<25	NP-5
35----------------Fordville	0-8	Loam-------------	ML, CL	A-4, A-6, A-7	0	100	100	70-85	55-75	30-45	5-20
	8-26	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	70-95	55-80	30-45	5-20
	26-32	Loam, clay loam, sandy loam.	CL, ML, SM, SC	A-4, A-6	0	95-100	90-100	65-90	40-55	25-40	3-15
	32-60	Loamy sand, gravelly loamy sand, very gravelly sand.	SW, SW-SM, SM	A-1	0	65-95	45-90	15-45	0-15	<25	NP-5
36*:											
Hecla-----------	0-9	Loamy fine sand	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	9-38	Loamy sand, loamy fine sand, fine sand.	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	12-35	<25	NP-7
	38-60	Loamy sand, fine sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	95-100	85-100	10-35	<25	NP-7
Ulen------------	0-20	Fine sandy loam	SM, SM-SC, SC	A-4	0	100	100	80-100	35-50	<25	NP-8
	20-36	Loamy fine sand, fine sand.	SM	A-2	0	100	95-100	70-95	12-35	---	NP
	36-60	Fine sand, loamy fine sand, sand.	SP-SM, SM	A-3, A-2	0	100	95-100	80-100	5-35	---	NP
37*:											
Forman----------	0-6	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	6-14	Clay loam--------	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-80	25-45	5-20
	14-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-80	25-45	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
37*:											
Cavour	0-12	Loam	ML, MH	A-4, A-6, A-7	0	100	90-100	85-100	60-85	30-55	5-20
	12-19	Clay, clay loam, silty clay loam.	CL, CH, MH, ML	A-7, A-6	0	100	90-100	90-100	55-85	35-65	15-30
	19-31	Clay loam, clay, loam.	CL, CH	A-7, A-6	0	95-100	90-100	85-100	60-85	35-65	15-35
	31-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	90-100	75-100	50-85	35-65	12-35
38*:											
Miranda	0-4	Loam	CL-ML, CL, ML	A-4, A-6	0	100	100	85-95	60-85	25-40	5-15
	4-27	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	50-80	30-50	10-30
	27-60	Loam, clay loam	CL, ML	A-6, A-7	0-5	95-100	95-100	85-95	50-80	25-50	10-35
Cavour	0-12	Loam	ML, MH	A-4, A-6, A-7	0	100	90-100	85-100	60-85	30-55	5-20
	12-19	Clay, clay loam, silty clay loam.	CL, CH, MH, ML	A-7, A-6	0	100	90-100	90-100	55-85	35-65	15-30
	19-31	Clay loam, clay, loam.	CL, CH	A-7, A-6	0	95-100	90-100	85-100	60-85	35-65	15-35
	31-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	90-100	75-100	50-85	35-65	12-35
39 Hamar	0-12	Loamy fine sand	SM, SM-SC	A-2, A-4	0	100	100	85-100	15-40	<25	NP-5
	12-60	Fine sand, loamy sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	100	70-100	10-35	<25	NP-5
40*:											
Hamerly	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	7-21	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	21-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Tonka	0-18	Silt loam	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-35	5-15
	18-43	Silty clay loam, clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	43-60	Silty clay loam, clay loam, loam.	CL, CL-ML	A-6, A-7, A-4	0-3	90-100	85-100	60-100	50-90	25-50	5-30
Parnell	0-11	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	11-26	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-80	20-50
	26-60	Clay, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
41 Colvin	0-21	Silt loam	CL	A-6	0	100	100	90-100	80-95	20-35	10-20
	21-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	20-50	10-30
42*:											
Hamerly	0-7	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	7-21	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	21-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	75-95	55-75	20-45	5-25

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
42*:											
Wyard-----------	0-19	Loam-------------	CL-ML, CL	A-4, A-6, A-7	0	95-100	90-100	85-100	60-90	25-45	5-25
	19-60	Loam, silt loam, clay loam.	ML, CL, SC, CL-ML	A-4, A-6, A-7	0-10	95-100	90-100	80-100	35-85	20-45	3-25
43--------------- Exline	0-8	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-20
	8-21	Clay, silty clay, silty clay loam.	MH, CH	A-7	0	100	100	95-100	90-100	60-90	30-50
	21-60	Silty clay loam, silty clay, clay.	CH, MH	A-7	0	100	100	95-100	85-100	50-80	20-45
44--------------- Harriet	0-2	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-20
	2-29	Clay, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-100	35-70	20-40
	29-60	Stratified very fine sandy loam to clay.	CL, CL-ML, CH	A-4, A-6, A-7	0	100	100	90-100	60-100	20-65	5-40
46--------------- Ludden	0-14	Clay-------------	CH	A-7	0	100	100	95-100	75-95	50-75	25-50
	14-30	Silty clay, clay	CH	A-7	0	100	100	95-100	75-95	50-75	25-50
	30-60	Silty clay, clay, clay loam.	CH	A-7	0	100	100	95-100	75-95	50-75	25-50
47, 48----------- La Prairie	0-18	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	85-95	70-80	25-40	5-15
	18-22	Silt loam, loam, silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	85-100	50-80	25-45	5-25
	22-29	Silt loam, loam, silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	85-100	70-80	25-45	5-25
	29-60	Stratified fine sandy loam to silty clay loam.	CL-ML, CL, SC, SM-SC	A-4, A-6, A-7	0	100	95-100	75-100	45-80	25-45	5-25
49--------------- Lamoure	0-15	Silt loam--------	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	15-36	Silty clay loam, silt loam.	CL, CH, MH, ML	A-7	0	100	100	90-100	85-100	40-70	15-35
	36-60	Silty clay loam, silt loam, loam.	CL, ML	A-6, A-7	0	95-100	95-100	90-100	75-100	30-50	10-20
50*:											
Wyndmere--------	0-8	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	60-80	30-55	---	NP
	8-41	Sandy loam, fine sandy loam.	SM, ML	A-2, A-4	0	100	100	60-80	30-55	---	NP
	41-54	Fine sand, loamy fine sand, fine sandy loam.	SM, ML	A-2, A-4	0	100	100	60-85	20-55	---	NP
	54-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	85-100	75-100	55-90	20-45	5-30
Tiffany---------	0-30	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	100	60-85	30-55	<30	NP-10
	30-60	Fine sandy loam, loamy fine sand, loamy very fine sand.	SM, ML	A-2, A-4	0	100	100	50-95	20-55	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
51*:											
Kratka----------	0-8	Fine sandy loam	SM, SM-SC	A-4	0	95-100	90-100	50-80	36-50	<25	2-6
	8-34	Loamy sand, fine sand, loamy fine sand.	SP-SM	A-3, A-2	0	95-100	90-100	50-80	5-10	---	NP
	34-60	Loam, clay loam, fine sandy loam.	SM-SC, SC, CL-ML, CL	A-4, A-6	0	95-100	90-100	70-90	40-60	15-40	5-25
Letcher---------	0-8	Fine sandy loam	SM, SM-SC	A-4	0	100	100	60-95	35-50	<30	NP-7
	8-22	Sandy loam, fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	100	60-95	20-45	<30	NP-7
	22-42	Loam, sandy loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-6, A-2	0	100	100	60-95	30-60	25-40	3-18
	42-60	Sandy loam, fine sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-6	0	100	95-100	50-95	30-60	25-40	3-18
52C*:											
Brantford-------	0-15	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	80-90	60-80	20-35	3-15
	15-60	Sand and gravel	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	5-25	50-95	30-75	15-60	5-30	<35	NP-10
Coe-------------	0-6	Loam-------------	ML, CL-ML	A-4	0-5	95-100	95-100	60-80	50-75	<25	NP-5
	6-60	Gravelly coarse sand, very gravelly loamy coarse sand, extremely gravelly loamy coarse sand.	SM, GP-GM, SP-SM, GM	A-1, A-2	5-25	50-95	30-75	15-60	10-30	<55	NP-15
53*:											
Brantford-------	0-15	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	80-90	60-80	20-35	3-15
	15-60	Sand and gravel	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	5-25	50-95	30-75	15-60	5-30	<35	NP-10
Vang------------	0-14	Loam-------------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-80	25-45	5-15
	14-32	Loam, clay loam, gravelly loam.	ML, CL, SM, SC	A-4, A-6, A-7	0	65-100	50-100	40-100	35-80	25-45	5-15
	32-60	Very gravelly sand, extremely gravelly sand, very gravelly loamy coarse sand.	SM, GM	A-1, A-2	5-25	50-95	30-75	15-60	15-30	---	NP
54--------------- Maddock	0-9	Fine sandy loam	SM	A-2, A-4	0	100	100	60-85	30-50	---	NP
	9-60	Sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	60-100	5-35	---	NP
56--------------- Overly	0-8	Silt loam--------	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	85-100	25-45	5-25
	8-42	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
	42-60	Stratified silt loam to silty clay.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
57*:											
Ryan	0-2	Silty clay	CH	A-7	0	100	100	95-100	90-95	50-75	25-50
	2-60	Silty clay, clay	CH	A-7	0	100	100	90-100	75-100	50-75	25-50
Ludden	0-14	Clay	CH	A-7	0	100	100	95-100	75-95	50-75	25-50
	14-30	Silty clay, clay	CH	A-7	0	100	100	95-100	75-95	50-75	25-50
	30-60	Silty clay, clay, clay loam.	CH	A-7	0	100	100	95-100	75-95	50-75	25-50
58 Renshaw	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	8-15	Loam, sandy clay loam, gravelly loam.	SM-SC, SC, ML, CL	A-4, A-6	0-5	95-100	55-100	45-90	35-70	25-40	3-15
	15-60	Gravelly loamy sand, very gravelly loamy sand, gravelly sand.	SW, SM, SW-SM, GW-GM	A-1, A-2	0-5	45-95	30-80	10-60	0-15	<25	NP-10
59*. Pits											
60B*:											
Renshaw	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	8-15	Loam, sandy clay loam, gravelly loam.	SM-SC, SC, ML, CL	A-4, A-6	0-5	95-100	55-100	45-90	35-70	25-40	3-15
	15-60	Gravelly loamy sand, very gravelly loamy sand, gravelly sand.	SW, SM, SW-SM, GW-GM	A-1, A-2	0-5	45-95	30-80	10-60	0-15	<35	NP-10
Sioux	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	8-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly coarse sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
61D Sioux	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	8-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly coarse sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
62C*:											
Sioux	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	8-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
Barnes	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
64 Sinai	0-9	Silty clay	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	9-25	Silty clay, silty clay loam, clay.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	25-49	Silty clay, silty clay loam, clay.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	49-60	Silty clay, silt loam, clay loam.	CL, CH	A-7	0	95-100	95-100	95-100	80-95	40-65	15-35
65B*:											
Serden	0-9	Fine sand	SM	A-2	0	100	100	65-85	15-25	---	NP
	9-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	100	65-85	5-25	---	NP
Hamar	0-12	Loamy fine sand	SM, SM-SC	A-2, A-4	0	100	100	85-100	15-40	<25	NP-5
	12-60	Fine sand, loamy sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	100	70-100	10-35	<25	NP-5
66 Spottswood	0-9	Loam	CL-ML, CL	A-6, A-4	0	95-100	95-100	90-100	65-90	25-40	5-15
	9-28	Clay loam, loam, gravelly loam.	CL	A-6, A-7	0	95-100	70-100	65-100	50-80	30-45	10-20
	28-60	Gravelly sand, loamy sand, very gravelly coarse sand.	SM, GM, SP-SM, SC	A-2, A-1	0-5	40-80	25-75	15-70	10-30	<35	NP-15
67 Stirum	0-6	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	100	60-95	30-60	15-25	NP-5
	6-18	Loam, fine sandy loam, sandy loam.	SC, CL, ML, SM	A-2, A-4	0	100	100	60-95	30-75	15-30	NP-10
	18-60	Stratified silt loam to loamy fine sand.	SM, CL, ML, SC	A-2, A-4, A-6	0	100	100	50-100	15-90	<30	NP-15
68*:											
Stirum	0-6	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	100	60-95	30-60	15-25	NP-5
	6-18	Loam, fine sandy loam, sandy loam.	SC, CL, ML, SM	A-2, A-4	0	100	100	60-95	30-75	15-30	NP-10
	18-60	Stratified silt loam to loamy fine sand.	SM, CL, ML, SC	A-2, A-4, A-6	0	100	100	50-100	15-90	<30	NP-15
Letcher	0-8	Fine sandy loam	SM, SM-SC	A-4	0	100	100	60-95	35-50	<30	NP-7
	8-22	Sandy loam, fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	100	60-95	20-45	<30	NP-7
	22-42	Loam, sandy loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-6, A-2	0	100	100	60-95	30-60	25-40	3-18
	42-60	Sandy loam, fine sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-6	0	100	95-100	50-95	30-60	25-40	3-18

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
69---------------- Letcher	0-8	Fine sandy loam	SM, SM-SC	A-4	0	100	100	60-95	35-50	<30	NP-7
	8-22	Sandy loam, fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	100	60-95	20-45	<30	NP-7
	22-42	Loam, sandy loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-6, A-2	0	100	100	60-95	30-60	25-40	3-18
	42-60	Sandy loam, fine sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-6	0	100	95-100	50-95	30-60	25-40	3-18
70---------------- Svea	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-29	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	29-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30
71*: Svea------------	0-8	Loam-------------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	8-29	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	29-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-100	60-85	20-50	5-30
Cresbard--------	0-12	Loam-------------	ML, CL	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	12-24	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	65-85	40-60	15-30
	24-34	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	85-100	65-85	40-60	15-30
	34-60	Clay loam, loam	CL, CH, ML, MH	A-6, A-7	0-5	95-100	90-100	85-100	60-80	35-55	10-27
72---------------- Swenoda	0-8	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	8-30	Fine sandy loam, sandy loam.	SM-SC, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-100	30-55	15-30	NP-10
	30-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	90-100	75-100	50-95	25-50	5-30
73*: Swenoda---------	0-8	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	8-30	Fine sandy loam, sandy loam.	SM-SC, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-100	30-55	15-30	NP-10
	30-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	90-100	75-100	50-95	25-50	5-30
Letcher---------	0-8	Fine sandy loam	SM, SM-SC	A-4	0	100	100	60-95	35-50	<30	NP-7
	8-22	Sandy loam, fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	100	60-95	20-45	<30	NP-7
	22-42	Loam, sandy loam, fine sandy loam.	SM, SC, ML, CL	A-4, A-6, A-2	0	100	100	60-95	30-60	25-40	3-18
	42-60	Sandy loam, fine sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-6	0	100	95-100	50-95	30-60	25-40	3-18
74*: Swenoda---------	0-8	Fine sandy loam	SM	A-2, A-4	0	100	95-100	70-100	30-50	20-30	NP-7
	8-30	Fine sandy loam, sandy loam.	SM-SC, SM, ML, CL-ML	A-2, A-4	0	100	95-100	60-100	30-55	15-30	NP-10
	30-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	90-100	75-100	50-95	25-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
74*:											
Barnes----------	0-8	Loam------------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	60-90	20-40	5-20
	8-15	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	15-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
77--------------- Towner	0-17	Loamy fine sand	SM, SM-SC	A-2	0	100	100	50-80	15-35	<25	NP-5
	17-32	Loamy sand, loamy fine sand, fine sand.	SM, SM-SC, SW-SM, SP-SM	A-2, A-3	0	100	95-100	50-100	5-35	<25	NP-5
	32-60	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	85-100	55-100	25-50	5-30
78--------------- Ulen	0-20	Fine sandy loam	SM, SM-SC, SC	A-4	0	100	100	80-100	35-50	<25	NP-8
	20-36	Loamy fine sand, fine sand.	SM	A-2	0	100	95-100	70-95	12-35	---	NP
	36-60	Fine sand, loamy fine sand, sand.	SP-SM, SM	A-3, A-2	0	100	95-100	80-100	5-35	---	NP
79*:											
Ulen------------	0-20	Fine sandy loam	SM, SM-SC, SC	A-4	0	100	100	80-100	35-50	<25	NP-8
	20-36	Loamy fine sand, fine sand.	SM	A-2	0	100	95-100	70-95	12-35	---	NP
	36-60	Fine sand, loamy fine sand, sand.	SP-SM, SM	A-3, A-2	0	100	95-100	80-100	5-35	---	NP
Hamar-----------	0-12	Loamy fine sand	SM, SM-SC	A-2, A-4	0	100	100	85-100	15-40	<25	NP-5
	12-60	Fine sand, loamy sand, loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	100	70-100	10-35	<25	NP-5
80*, 81B*:											
Makoti----------	0-9	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	20-45	3-25
	9-34	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	60-95	20-45	3-28
	34-60	Stratified very fine sandy loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-45	3-28
Sakakawea-------	0-7	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	80-95	55-75	25-40	5-20
	7-26	Silt loam, loam	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	65-85	20-40	5-25
	26-60	Stratified loamy sand to silty clay.	SM, SC, ML, CL	A-2, A-4, A-6	0	100	95-100	50-100	10-85	15-40	NP-25
85B*:											
Lehr------------	0-9	Loam------------	ML, CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-80	20-40	3-15
	9-17	Loam, clay loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	95-100	90-100	80-95	45-75	25-40	5-15
	17-60	Gravelly loamy sand, gravelly sand, gravelly coarse sand.	SM, SP, GM, GP	A-1	0-5	40-80	25-60	10-35	2-15	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
85B*:											
Wabek-----------	0-6	Loam-------------	ML	A-4	0-1	90-100	90-100	75-90	50-70	25-40	NP-10
	6-60	Sand and gravel	GM, SM, SP, SW	A-1	0-1	25-90	10-65	5-35	0-25	---	NP
86E-------------- Wabek	0-6	Loam-------------	ML	A-4	0-1	90-100	90-100	75-90	50-70	25-40	NP-10
	6-60	Sand and gravel	GM, SM, SP, SW	A-1	0-1	25-90	10-65	5-35	0-25	---	NP
90--------------- Vallers	0-8	Loam-------------	ML, CL-ML	A-4	0	95-100	90-100	80-90	50-80	30-40	4-10
	8-22	Clay loam, silty clay loam, loam.	CL	A-6	0	95-100	90-100	80-95	50-80	30-40	11-20
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-95	60-85	20-40	5-20
91B-------------- Ruso	0-8	Sandy loam-------	SM, SC, SM-SC	A-2, A-4	0-1	95-100	95-100	60-70	30-40	<25	NP-10
	8-26	Coarse sandy loam, sandy loam.	SM, SC, SM-SC	A-2, A-4	0-1	85-100	85-100	60-80	30-40	<25	NP-10
	26-60	Sand and gravel	SP, SM, GM, GP	A-1, A-2	0-5	35-90	25-90	10-40	3-35	---	NP
92B*:											
Williams--------	0-7	Loam-------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	7-19	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	19-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Bowbells--------	0-6	Loam-------------	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-90	20-40	3-23
	6-19	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	19-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
93C*:											
Williams--------	0-7	Loam-------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	7-19	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	19-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Zahl------------	0-5	Loam-------------	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam-------------	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
94C-------------- Williams	0-7	Loam-------------	CL, CL-ML	A-4, A-6, A-7	3-25	95-100	95-100	85-95	60-90	25-45	5-25
	7-19	Loam, clay loam	CL	A-6, A-7	0-20	95-100	95-100	80-95	60-80	30-50	10-30
	19-60	Loam, clay loam	CL	A-6, A-7	0-15	95-100	95-100	80-95	60-80	30-50	10-30
95B*:											
Bowbells--------	0-6	Loam-------------	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-90	20-40	3-23
	6-19	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	19-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
Zahl------------	0-5	Loam-------------	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam-------------	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
96E*:											
Zahl------------	0-5	Loam-------------	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam-------------	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Williams--------	0-7	Loam-------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	7-19	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	19-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
97F*:											
Zahl------------	0-5	Loam-------------	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam-------------	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Max-------------	0-17	Loam-------------	ML, CL, CL-ML	A-4, A-6, A-7	0-3	95-100	90-100	85-95	60-75	25-45	3-23
	17-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6, A-7	0-3	95-100	90-100	85-100	60-80	25-45	3-23
98D*:											
Williams--------	0-7	Loam-------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	7-19	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	19-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Zahl------------	0-5	Loam-------------	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam-------------	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Parnell---------	0-11	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	11-26	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-100	40-80	20-50
	26-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
2*:									
Overly----------	0-8	0.2-0.6	0.22-0.24	6.6-7.8	<2	Moderate	0.32	5	6
	8-42	0.2-0.6	0.17-0.22	6.6-8.4	<2	Moderate	0.32		
	42-60	0.06-0.6	0.13-0.22	7.9-8.4	<2	Moderate	0.32		
Aberdeen--------	0-13	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate	0.32	3	6
	13-27	0.06-0.2	0.13-0.18	6.6-8.4	<4	High------	0.32		
	27-60	0.06-0.2	0.14-0.17	7.4-9.0	2-8	High------	0.43		
3*:									
Aberdeen--------	0-13	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate	0.32	3	6
	13-27	0.06-0.2	0.13-0.18	6.6-8.4	<4	High------	0.32		
	27-60	0.06-0.2	0.14-0.17	7.4-9.0	2-8	High------	0.43		
Exline----------	0-8	0.6-2.0	0.19-0.22	6.1-7.8	<2	Low-------	0.37	3	6
	8-21	<0.06	0.10-0.15	6.6-9.0	4-16	High------	0.28		
	21-60	0.06-0.2	0.14-0.17	7.9-9.0	4-8	High------	0.43		
4---------------- Rosewood	0-9	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.24	3	3
	9-26	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low-------	0.24		
	26-60	6.0-20	0.05-0.08	7.4-8.4	<2	Low-------	0.24		
6---------------- Parnell	0-11	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
	11-26	0.06-0.2	0.13-0.19	6.1-7.8	<2	High------	0.28		
	26-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		
7---------------- Southam	0-8	0.2-0.6	0.22-0.24	6.6-8.4	2-8	Moderate	0.37	5	6
	8-24	0.06-0.2	0.14-0.20	6.6-8.4	2-8	High------	0.28		
	24-60	0.06-0.6	0.13-0.17	7.4-9.0	2-8	High------	0.28		
8---------------- Tonka	0-18	0.6-2.0	0.18-0.23	5.6-7.8	<2	Low-------	0.32	5	6
	18-43	0.06-0.2	0.14-0.19	5.6-7.8	<2	High------	0.43		
	43-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	0.43		
9---------------- Bearden	0-13	0.6-2.0	0.20-0.24	7.4-8.4	<4	Moderate	0.28	5	4L
	13-36	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate	0.28		
	36-60	0.06-2.0	0.16-0.22	7.4-8.4	<4	Moderate	0.43		
10--------------- Glyndon	0-9	0.6-2.0	0.13-0.15	7.4-9.0	4-16	Low-------	0.28	5	4L
	9-21	2.0-6.0	0.11-0.13	7.9-9.0	4-16	Low-------	0.28		
	21-60	2.0-20	0.09-0.12	7.9-8.4	4-16	Low-------	0.28		
12B-------------- Arvilla	0-9	2.0-6.0	0.13-0.15	6.6-8.4	<2	Low-------	0.20	3	3
	9-19	2.0-6.0	0.11-0.14	6.6-8.4	<2	Low-------	0.20		
	19-60	>6.0	0.02-0.05	7.4-8.4	<2	Low-------	0.10		
13--------------- Rosewood	0-9	2.0-6.0	0.13-0.18	7.9-8.4	<2	Low-------	0.24	3	3
	9-26	2.0-6.0	0.11-0.15	7.9-8.4	<2	Low-------	0.24		
	26-60	6.0-20	0.05-0.08	7.4-8.4	<2	Low-------	0.24		
14*:									
Barnes----------	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low-------	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
14*:									
Gardena	0-12	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low	0.28	5	5
	12-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low	0.43		
15*, 15B*:									
Barnes	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-29	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	29-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
16B*:									
Barnes	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-40	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
	40-60	0.2-0.6	0.14-0.19	7.4-8.4	<8	Moderate	0.37		
Cresbard	0-12	0.6-2.0	0.17-0.20	5.6-7.3	<2	Low	0.32	3	6
	12-24	0.06-0.6	0.11-0.14	5.6-7.8	2-4	High	0.32		
	24-34	0.06-0.6	0.11-0.15	6.1-8.4	2-4	High	0.32		
	34-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.32		
17B*, 17C*:									
Barnes	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Buse	0-6	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	6-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
18B*:									
Barnes	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-40	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
	40-60	0.2-0.6	0.14-0.19	7.4-8.4	<8	Moderate	0.37		
Cavour	0-12	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	12-31	<0.2	0.10-0.16	6.6-9.0	4-16	High	0.37		
	31-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate	0.37		
19E*:									
Buse	0-6	0.2-0.6	0.17-0.22	6.6-8.4	<2	Low	0.28	5	4L
	6-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Barnes	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
21*:									
Cavour	0-12	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	12-19	<0.2	0.10-0.16	6.6-8.4	4-16	High	0.37		
	19-31	<0.2	0.10-0.16	7.4-9.0	8-16	High	0.37		
	31-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate	0.37		
Miranda	0-4	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.32	3	6
	4-27	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate	0.32		
	27-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate	0.32		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
22, 23----------- Colvin	0-21	0.6-2.0	0.20-0.22	7.4-9.0	<2	Moderate	0.32	5	4L
	21-36	0.06-2.0	0.16-0.20	7.4-9.0	<2	Moderate	0.32		
	36-60	0.06-2.0	0.15-0.20	7.4-9.0	<2	Moderate	0.32		
24--------------- Gardena	0-12	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low--------	0.28	5	5
	12-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43		
25--------------- Divide	0-13	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.28	4	4L
	13-28	0.6-2.0	0.16-0.19	7.4-8.4	<2	Low--------	0.28		
	28-60	>6.0	0.03-0.07	7.4-8.4	<2	Low--------	0.10		
26B*:									
Eckman----------	0-7	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low--------	0.28	5	5
	7-35	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low--------	0.43		
	35-60	0.6-2.0	0.14-0.22	7.4-8.4	<2	Low--------	0.43		
Gardena---------	0-12	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low--------	0.28	5	5
	12-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43		
27B-------------- Embden	0-10	2.0-6.0	0.13-0.18	6.6-7.3	<2	Low--------	0.20	5	3
	10-20	2.0-6.0	0.12-0.17	6.6-7.8	<2	Low--------	0.20		
	20-60	2.0-6.0	0.06-0.16	6.6-8.4	<2	Low--------	0.20		
28B-------------- Clontarf	0-8	2.0-6.0	0.13-0.18	6.1-7.3	<2	Low--------	0.20	4	3
	8-28	2.0-6.0	0.12-0.19	6.1-7.8	<2	Low--------	0.20		
	28-60	6.0-20	0.05-0.09	6.6-7.8	<2	Low--------	0.15		
29--------------- Glyndon	0-9	0.6-2.0	0.20-0.23	7.4-9.0	<4	Low--------	0.28	5	4L
	9-21	0.6-6.0	0.17-0.20	7.4-9.0	<4	Low--------	0.28		
	21-60	2.0-6.0	0.15-0.19	7.4-9.0	<4	Low--------	0.28		
31, 31B---------- Edgeley	0-6	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low--------	0.28	4	6
	6-34	0.6-2.0	0.13-0.19	6.1-8.4	<2	Moderate	0.28		
	34-60	---	---	---	---	-----------	----		
33--------------- Hecla	0-9	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17	5	2
	9-38	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17		
	38-60	2.0-20	0.06-0.10	6.1-8.4	<2	Low--------	0.17		
34*:									
Hecla-----------	0-9	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17	5	2
	9-38	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17		
	38-60	2.0-20	0.06-0.10	6.1-8.4	<2	Low--------	0.17		
Hamar-----------	0-12	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17	5	2
	12-60	2.0-20	0.06-0.08	7.4-8.4	<2	Low--------	0.17		
35--------------- Fordville	0-8	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low--------	0.24	4	6
	8-26	0.6-2.0	0.18-0.21	6.1-7.8	<2	Moderate	0.24		
	26-32	0.6-6.0	0.12-0.18	6.1-8.4	<2	Low--------	0.24		
	32-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low--------	0.10		
36*:									
Hecla-----------	0-9	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17	5	2
	9-38	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17		
	38-60	2.0-20	0.06-0.10	6.1-8.4	<2	Low--------	0.17		
Ulen------------	0-20	2.0-6.0	0.13-0.18	7.4-8.4	<4	Low--------	0.17	5	3
	20-36	6.0-20	0.06-0.10	7.9-8.4	<4	Low--------	0.17		
	36-60	6.0-20	0.06-0.08	7.4-8.4	<4	Low--------	0.17		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
37*:									
Forman----------	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	6-14	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.28		
	14-60	0.06-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
Cavour----------	0-12	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	12-19	<0.2	0.10-0.16	6.6-8.4	4-16	High------	0.37		
	19-31	<0.2	0.10-0.16	7.4-9.0	8-16	High------	0.37		
	31-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate	0.37		
38*:									
Miranda---------	0-4	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-------	0.32	3	6
	4-27	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate	0.32		
	27-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate	0.32		
Cavour----------	0-12	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	12-19	<0.2	0.10-0.16	6.6-8.4	4-16	High------	0.37		
	19-31	<0.2	0.10-0.16	7.4-9.0	8-16	High------	0.37		
	31-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate	0.37		
39--------------- Hamar	0-12	2.0-20	0.10-0.12	6.1-7.8	<2	Low-------	0.17	5	2
	12-60	2.0-20	0.06-0.08	7.4-8.4	<2	Low-------	0.17		
40*:									
Hamerly---------	0-7	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
	7-21	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	21-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Tonka-----------	0-18	0.6-2.0	0.18-0.23	5.6-7.8	<2	Low-------	0.32	5	6
	18-43	0.06-0.2	0.14-0.19	5.6-7.8	<2	High------	0.43		
	43-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	0.43		
Parnell---------	0-11	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
	11-26	0.06-0.2	0.13-0.19	6.1-7.8	<2	High------	0.28		
	26-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		
41--------------- Colvin	0-21	0.6-2.0	0.15-0.17	7.4-9.0	4-16	Moderate	0.32	5	4L
	21-60	0.06-2.0	0.11-0.15	7.4-9.0	4-16	Moderate	0.32		
42*:									
Hamerly---------	0-7	0.6-2.0	0.18-0.24	6.6-8.4	<2	Moderate	0.28	5	4L
	7-21	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	21-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Wyard-----------	0-19	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.28	5	6
	19-60	0.6-2.0	0.14-0.22	7.4-8.4	<2	Moderate	0.37		
43--------------- Exline	0-8	0.6-2.0	0.19-0.22	6.1-7.8	<2	Low-------	0.37	3	6
	8-21	<0.06	0.10-0.15	6.6-9.0	4-16	High------	0.28		
	21-60	0.06-0.2	0.14-0.17	7.9-9.0	4-8	High------	0.43		
44--------------- Harriet	0-2	0.06-0.2	0.20-0.24	6.6-8.4	<2	Moderate	0.37	3	6
	2-29	<0.06	0.10-0.15	>7.3	4-16	High------	0.37		
	29-60	0.06-0.2	0.10-0.15	>7.8	4-16	Moderate	0.37		
46--------------- Ludden	0-14	0.06-0.2	0.16-0.18	6.1-8.4	<4	High------	0.28	5	4
	14-30	0.06-0.2	0.13-0.16	7.9-8.4	<4	High------	0.28		
	30-60	0.06-0.2	0.13-0.16	7.9-8.4	<8	High------	0.28		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
47, 48----------- La Prairie	0-18	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low--------	0.28	5	6
	18-22	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28		
	22-29	0.6-2.0	0.15-0.22	6.6-8.4	<2	Moderate	0.28		
	29-60	0.6-2.0	0.15-0.22	6.6-8.4	<2	Moderate	0.28		
49--------------- Lamoure	0-15	0.2-2.0	0.19-0.22	7.4-8.4	<4	Moderate	0.28	5	4L
	15-36	0.2-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.28		
	36-60	0.2-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.28		
50*:									
Wyndmere---------	0-8	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low--------	0.20	5	3
	8-41	2.0-6.0	0.12-0.17	7.4-8.4	<2	Low--------	0.20		
	41-54	2.0-6.0	0.06-0.16	7.4-8.4	<2	Low--------	0.20		
	54-60	0.2-2.0	0.14-0.22	7.4-8.4	<2	Moderate	0.28		
Tiffany----------	0-30	0.6-2.0	0.13-0.18	6.1-7.8	<2	Low--------	0.20	5	3
	30-60	0.6-6.0	0.10-0.17	6.6-7.8	<2	Low--------	0.20		
51*:									
Kratka-----------	0-8	2.0-6.0	0.13-0.18	5.6-7.8	<2	Low--------	0.17	5	3
	8-34	2.0-6.0	0.06-0.11	5.6-7.8	<2	Low--------	0.17		
	34-60	0.2-2.0	0.11-0.19	7.4-8.4	<2	Moderate	0.32		
Letcher----------	0-8	0.6-2.0	0.11-0.17	5.1-7.8	<2	Low--------	0.20	3	3
	8-22	0.6-6.0	0.10-0.15	5.1-7.8	<2	Low--------	0.24		
	22-42	0.06-0.2	0.08-0.14	6.6-9.0	2-8	Low--------	0.24		
	42-60	0.6-6.0	0.11-0.18	7.4-9.0	2-8	Low--------	0.24		
52C*:									
Brantford--------	0-15	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low--------	0.28	3	6
	15-60	>20	0.02-0.05	7.4-8.4	<2	Low--------	0.10		
Coe--------------	0-6	0.6-2.0	0.18-0.22	6.6-7.8	<2	Low--------	0.28	2	5
	6-60	>20	0.02-0.05	7.4-8.4	<2	Low--------	0.15		
53*:									
Brantford--------	0-15	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low--------	0.28	3	6
	15-60	>20	0.02-0.05	7.4-8.4	<2	Low--------	0.10		
Vang-------------	0-14	0.6-2.0	0.17-0.21	6.1-7.3	<2	Low--------	0.28	4	6
	14-32	0.6-2.0	0.15-0.19	6.1-8.4	<2	Low--------	0.28		
	32-60	>6.0	0.02-0.04	6.1-8.4	<2	Low--------	0.10		
54--------------- Maddock	0-9	6.0-20	0.13-0.18	6.6-7.8	<2	Low--------	0.17	5	3
	9-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low--------	0.17		
56--------------- Overly	0-8	0.2-0.6	0.22-0.24	6.6-7.8	<2	Moderate	0.32	5	6
	8-42	0.2-0.6	0.17-0.22	6.6-8.4	<2	Moderate	0.32		
	42-60	0.06-0.6	0.13-0.22	7.9-8.4	<2	Moderate	0.32		
57*:									
Ryan-------------	0-2	<0.06	0.15-0.18	7.4-8.4	<2	High-------	0.28	3	4
	2-60	<0.06	0.10-0.14	7.4-9.0	4-16	High-------	0.28		
Ludden-----------	0-14	0.06-0.2	0.08-0.09	6.1-8.4	4-8	High-------	0.28	5	4
	14-30	0.06-0.2	0.06-0.08	7.9-8.4	8-16	High-------	0.28		
	30-60	0.06-0.2	0.06-0.08	7.9-8.4	8-16	High-------	0.28		
58--------------- Renshaw	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Low--------	0.28	3	6
	8-15	0.6-6.0	0.11-0.18	6.6-8.4	<2	Low--------	0.28		
	15-60	>6.0	0.03-0.06	6.6-8.4	<2	Low--------	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
59*. Pits									
60B*:									
Renshaw----------	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Low--------	0.28	3	6
	8-15	0.6-6.0	0.11-0.18	6.6-8.4	<2	Low--------	0.28		
	15-60	>6.0	0.03-0.06	6.6-8.4	<2	Low--------	0.10		
Sioux------------	0-8	0.6-2.0	0.18-0.20	6.6-8.4	<2	Low--------	0.28	2	5
	8-60	>6.0	0.03-0.06	7.4-8.4	<2	Low--------	0.10		
61D--------------- Sioux	0-8	0.6-2.0	0.18-0.20	6.6-8.4	<2	Low--------	0.28	2	5
	8-60	>6.0	0.03-0.06	7.4-8.4	<2	Low--------	0.10		
62C*:									
Sioux------------	0-8	0.6-2.0	0.18-0.20	6.6-8.4	<2	Low--------	0.28	2	5
	8-60	>6.0	0.03-0.06	7.4-8.4	<2	Low--------	0.10		
Barnes-----------	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low--------	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
64---------------- Sinai	0-9	0.06-0.2	0.13-0.16	6.1-7.3	<2	High-------	0.28	5	4
	9-25	0.06-0.2	0.17-0.19	6.6-7.8	<2	High-------	0.28		
	25-49	0.06-0.2	0.11-0.17	7.4-8.4	<2	High-------	0.28		
	49-60	0.06-0.2	0.11-0.17	7.4-8.4	<2	High-------	0.43		
65B*:									
Serden-----------	0-9	6.0-20	0.06-0.12	6.1-7.3	<2	Low--------	0.15	5	1
	9-60	6.0-20	0.05-0.07	6.6-7.8	<2	Low--------	0.15		
Hamar------------	0-12	2.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17	5	2
	12-60	2.0-20	0.06-0.08	7.4-8.4	<2	Low--------	0.17		
66---------------- Spottswood	0-9	0.6-2.0	0.18-0.22	6.1-7.3	<2	Low--------	0.24	4	6
	9-28	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.24		
	28-60	6.0-20	0.03-0.06	7.4-9.0	<2	Low--------	0.10		
67---------------- Stirum	0-6	2.0-6.0	0.10-0.13	7.4-8.4	2-8	Low--------	0.24	3	3
	6-18	0.2-0.6	0.12-0.18	>7.8	2-16	Low--------	0.32		
	18-60	0.6-20	0.06-0.18	>7.8	2-16	Low--------	0.17		
68*:									
Stirum-----------	0-6	2.0-6.0	0.10-0.13	7.4-8.4	2-8	Low--------	0.24	3	3
	6-18	0.2-0.6	0.12-0.18	>7.8	2-16	Low--------	0.32		
	18-60	0.6-20	0.06-0.18	>7.8	2-16	Low--------	0.17		
Letcher----------	0-8	0.6-2.0	0.11-0.17	5.1-7.8	<2	Low--------	0.20	3	3
	8-22	0.6-6.0	0.10-0.15	5.1-7.8	<2	Low--------	0.24		
	22-42	0.06-0.2	0.08-0.14	6.6-9.0	2-8	Low--------	0.24		
	42-60	0.6-6.0	0.11-0.18	7.4-9.0	2-8	Low--------	0.24		
69---------------- Letcher	0-8	0.6-2.0	0.11-0.17	5.1-7.8	<2	Low--------	0.20	3	3
	8-22	0.6-6.0	0.10-0.15	5.1-7.8	<2	Low--------	0.24		
	22-42	0.06-0.2	0.08-0.14	6.6-9.0	2-8	Low--------	0.24		
	42-60	0.6-6.0	0.11-0.18	7.4-9.0	2-8	Low--------	0.24		
70---------------- Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.28	5	6
	8-29	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	29-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
71*:									
Svea	0-8	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low	0.28	5	6
	8-29	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	29-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Cresbard	0-12	0.6-2.0	0.17-0.20	5.6-7.3	<2	Low	0.32	3	6
	12-24	0.06-0.6	0.11-0.14	5.6-7.8	2-4	High	0.32		
	24-34	0.06-0.6	0.11-0.15	6.1-8.4	2-4	High	0.32		
	34-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.32		
72 Swenoda	0-8	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low	0.20	5	3
	8-30	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low	0.20		
	30-60	0.2-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.37		
73*:									
Swenoda	0-8	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low	0.20	5	3
	8-30	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low	0.20		
	30-60	0.2-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.37		
Letcher	0-8	0.6-2.0	0.11-0.17	5.1-7.8	<2	Low	0.20	3	3
	8-22	0.6-6.0	0.10-0.15	5.1-7.8	<2	Low	0.24		
	22-42	0.06-0.2	0.08-0.14	6.6-9.0	2-8	Low	0.24		
	42-60	0.6-6.0	0.11-0.18	7.4-9.0	2-8	Low	0.24		
74*:									
Swenoda	0-8	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low	0.20	5	3
	8-30	2.0-6.0	0.11-0.17	6.6-7.8	<2	Low	0.20		
	30-60	0.2-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.37		
Barnes	0-8	0.6-2.0	0.13-0.24	5.6-7.8	<2	Low	0.28	5	6
	8-15	0.6-2.0	0.15-0.19	6.1-7.8	<4	Moderate	0.28		
	15-60	0.2-0.6	0.14-0.19	7.4-8.4	<4	Moderate	0.37		
77 Towner	0-17	6.0-20	0.08-0.12	6.6-7.8	<2	Low	0.17	5	2
	17-32	6.0-20	0.06-0.13	6.6-7.8	<2	Low	0.17		
	32-60	0.2-2.0	0.14-0.22	7.4-8.4	<2	Moderate	0.37		
78 Ulen	0-20	2.0-6.0	0.13-0.18	7.4-8.4	<4	Low	0.17	5	3
	20-36	6.0-20	0.06-0.10	7.9-8.4	<4	Low	0.17		
	36-60	6.0-20	0.06-0.08	7.4-8.4	<4	Low	0.17		
79*:									
Ulen	0-20	2.0-6.0	0.13-0.18	7.4-8.4	<4	Low	0.17	5	3
	20-36	6.0-20	0.06-0.10	7.9-8.4	<4	Low	0.17		
	36-60	6.0-20	0.06-0.08	7.4-8.4	<4	Low	0.17		
Hamar	0-12	2.0-20	0.10-0.12	6.1-7.8	<2	Low	0.17	5	2
	12-60	2.0-20	0.06-0.08	7.4-8.4	<2	Low	0.17		
80*, 81B*:									
Makoti	0-9	0.2-0.6	0.22-0.24	6.6-7.3	<2	Moderate	0.32	5	6
	9-34	0.2-0.6	0.16-0.24	6.1-7.8	<2	Moderate	0.32		
	34-60	0.2-0.6	0.16-0.22	7.4-8.4	<2	Moderate	0.43		
Sakakawea	0-7	0.6-2.0	0.20-0.22	6.6-7.8	<2	Moderate	0.28	5	4L
	7-26	0.6-2.0	0.16-0.22	6.6-7.8	<2	Moderate	0.28		
	26-60	0.6-2.0	0.08-0.20	7.9-8.4	<2	Moderate	0.28		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
85B*:									
Lehr------------	0-9	2.0-6.0	0.17-0.22	6.6-7.3	<2	Low-------	0.28	3	5
	9-17	2.0-6.0	0.17-0.20	6.6-8.4	<2	Moderate	0.28		
	17-60	>6.0	0.02-0.04	7.4-8.4	<2	Low-------	0.10		
Wabek-----------	0-6	2.0-6.0	0.20-0.22	6.6-8.4	<2	Low-------	0.28	2	5
	6-60	>20	0.02-0.04	7.4-8.4	<2	Low-------	0.10		
86E-------------- Wabek	0-6	2.0-6.0	0.20-0.22	6.6-8.4	<2	Low-------	0.28	2	5
	6-60	>20	0.02-0.04	7.4-8.4	<2	Low-------	0.10		
90--------------- Vallers	0-8	0.6-2.0	0.22-0.24	7.4-8.4	<4	Low-------	0.28	5	4L
	8-22	0.2-0.6	0.15-0.19	7.4-8.4	<4	Moderate	0.28		
	22-60	0.2-0.6	0.17-0.19	7.4-8.4	<4	Low-------	0.28		
91B-------------- Ruso	0-8	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low-------	0.20	4	3
	8-26	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low-------	0.20		
	26-60	>20	0.02-0.04	7.4-8.4	<2	Low-------	0.10		
92B*:									
Williams--------	0-7	0.6-2.0	0.17-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	7-19	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	19-60	0.2-0.6	0.15-0.18	7.4-8.4	<2	Moderate	0.37		
Bowbells--------	0-6	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low-------	0.28	5	6
	6-19	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate	0.28		
	19-60	0.2-0.6	0.14-0.18	7.4-8.4	<2	Moderate	0.37		
93C*:									
Williams--------	0-7	0.6-2.0	0.17-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	7-19	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	19-60	0.2-0.6	0.15-0.18	7.4-8.4	<2	Moderate	0.37		
Zahl------------	0-5	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	5-20	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
	20-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
94C-------------- Williams	0-7	0.6-2.0	0.17-0.24	6.6-7.8	<2	Low-------	0.20	5	8
	7-19	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.32		
	19-60	0.2-0.6	0.15-0.18	7.4-8.4	<2	Moderate	0.32		
95B*:									
Bowbells--------	0-6	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low-------	0.28	5	6
	6-19	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate	0.28		
	19-60	0.2-0.6	0.14-0.18	7.4-8.4	<2	Moderate	0.37		
Zahl------------	0-5	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	5-20	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
	20-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
96E*:									
Zahl------------	0-5	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	5-20	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
	20-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
Williams--------	0-7	0.6-2.0	0.17-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	7-19	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	19-60	0.2-0.6	0.15-0.18	7.4-8.4	<2	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
97F*:									
Zahl------------	0-5	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	5-20	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
	20-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
Max-------------	0-17	0.6-2.0	0.20-0.22	6.6-7.8	<2	Moderate	0.28	5	6
	17-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
98D*:									
Williams--------	0-7	0.6-2.0	0.17-0.24	6.6-7.8	<2	Low-------	0.28	5	6
	7-19	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	19-60	0.2-0.6	0.15-0.18	7.4-8.4	<2	Moderate	0.37		
Zahl------------	0-5	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	5-20	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
	20-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
Parnell---------	0-11	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
	11-26	0.06-0.2	0.13-0.19	6.1-7.8	<2	High------	0.28		
	26-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High------	0.28		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
2*:												
Overly	C	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	High	High	Low.
Aberdeen	C	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Moderate.
3*:												
Aberdeen	C	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Moderate.
Exline	D	None	---	---	2.5-4.0	Apparent	Apr-Jun	>60	---	Moderate	High	High.
4 Rosewood	A/D	None	---	---	0-2.0	Apparent	Apr-Jul	>60	---	High	High	Low.
6 Parnell	C/D	None	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	High	High	Low.
7 Southam	D	None	---	---	+5-1.0	Apparent	Jan-Dec	>60	---	High	High	Low.
8 Tonka	C/D	None	---	---	+.5-1.0	Apparent	Apr-Jun	>60	---	High	High	Low.
9 Bearden	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High	High	Low.
10 Glyndon	B	None	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	High	High	Moderate.
12B Arvilla	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
13 Rosewood	A/D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	High	High	Low.
14*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Gardena	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	High	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
15*, 15B*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Svea	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Low.
16B*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Cresbard	C	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High	Moderate.
17B*, 17C*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
18B*:												
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Cavour	D	None	---	---	4.0-6.0	---	---	>60	---	Moderate	High	Moderate.
19E*:												
Buse	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Barnes	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
21*:												
Cavour	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
Miranda	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
22 Colvin	C/D	None	---	---	0-1.0	Apparent	Apr-Jul	>60	---	High	High	Low.
23 Colvin	C/D	None	---	---	+1-1.0	Apparent	Jan-Dec	>60	---	High	High	Low.
24 Gardena	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	High	Moderate	Low.
25 Divide	B	None	---	---	2.5-5.0	Apparent	Apr-Jun	>60	---	Moderate	High	Low.
26B*:												
Eckman	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
Gardena	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	High	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
27B---------------- Embden	B	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High------	Low.
28B---------------- Clontarf	B	None---------	---	---	3.0-5.0	Apparent	Nov-Jun	>60	---	Moderate	Low-------	Low.
29----------------- Glyndon	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	High------	High------	Low.
31, 31B------------ Edgeley	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Low.
33----------------- Hecla	A	None---------	---	---	3.0-6.0	Apparent	Apr-Oct	>60	---	Moderate	Moderate	Low.
34*:												
Hecla-------------	A	None---------	---	---	3.0-6.0	Apparent	Apr-Oct	>60	---	Moderate	Moderate	Low.
Hamar-------------	A/D	None---------	---	---	0.5-2.0	Apparent	Oct-Jun	>60	---	Moderate	High------	Low.
35----------------- Fordville	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
36*:												
Hecla-------------	A	None---------	---	---	3.0-6.0	Apparent	Apr-Oct	>60	---	Moderate	Moderate	Low.
Ulen--------------	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	Moderate	Low-------	Low.
37*:												
Forman------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Cavour------------	D	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
38*:												
Miranda-----------	D	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
Cavour------------	D	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
39----------------- Hamar	A/D	None---------	---	---	0.5-2.0	Apparent	Oct-Jun	>60	---	Moderate	High------	Low.
40*:												
Hamerly-----------	C	None---------	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High------	High------	Low.
Tonka-------------	C/D	None---------	---	---	+.5-1.0	Apparent	Apr-Jun	>60	---	High------	High------	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
40*:												
Parnell	C/D	None	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	High	High	Low.
41 Colvin	C/D	None	---	---	0-2.0	Apparent	Apr-Jul	>60	---	High	High	Moderate.
42*:												
Hamerly	C	None	---	---	2.0-4.0	Apparent	Apr-Jun	>60	---	High	High	Low.
Wyard	B	None	---	---	1.0-3.0	Apparent	Mar-Jun	>60	---	High	High	Low.
43 Exline	D	None	---	---	2.5-4.0	Apparent	Apr-Jun	>60	---	Moderate	High	High.
44 Harriet	D	Occasional	Long	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	High	High	Moderate.
46 Ludden	D	Occasional	Brief to long.	Mar-Jun	0-2.0	Apparent	Mar-Jun	>60	---	High	High	Low.
47 La Prairie	B	Frequent	Brief	Mar-Jun	3.5-6.0	Apparent	Mar-Jun	>60	---	Moderate	Moderate	Low.
48 La Prairie	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
49 Lamoure	C	Occasional	Brief	Mar-Oct	0-2.0	Apparent	Oct-Jun	>60	---	High	High	Moderate.
50*:												
Wyndmere	B	None	---	---	2.0-5.0	Apparent	Sep-Jun	>60	---	High	High	Low.
Tiffany	B/D	None	---	---	+1-3.0	Apparent	Apr-Jun	>60	---	High	High	Low.
51*:												
Kratka	B/D	None	---	---	0.5-3.0	Apparent	Apr-Jul	>60	---	Moderate	High	Low.
Letcher	D	None	---	---	3.5-6.0	Perched	Nov-Jun	>60	---	Moderate	High	Moderate.
52C*:												
Brantford	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Coe	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
53*:												
Brantford--------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Vang-------------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
54---------------- Maddock	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
56---------------- Overly	C	None--------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
57*:												
Ryan-------------	D	Occasional	Brief to long.	Mar-Jun	0-1.0	Apparent	Apr-Jul	>60	---	Moderate	High-----	Moderate.
Ludden-----------	D	Occasional	Brief to long.	Mar-Jun	0-2.0	Apparent	Mar-Jun	>60	---	High-----	High-----	Moderate.
58---------------- Renshaw	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
59*. Pits												
60B*:												
Renshaw----------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Sioux------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
61D--------------- Sioux	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
62C*:												
Sioux------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
Barnes-----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
64---------------- Sinai	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	High.
65B*:												
Serden-----------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Hamar------------	A/D	None--------	---	---	0.5-2.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
66----------------- Spottswood	B	None---------	---	---	3.0-6.0	Apparent	Oct-Jun	>60	---	Moderate	High------	Low.
67----------------- Stirum	B/D	None---------	---	---	1.0-3.0	Apparent	Apr-Jul	>60	---	Moderate	High------	Moderate.
68*:												
Stirum------------	B/D	None---------	---	---	1.0-3.0	Apparent	Apr-Jul	>60	---	Moderate	High------	Moderate.
Letcher-----------	D	None---------	---	---	3.5-6.0	Perched	Nov-Jun	>60	---	Moderate	High------	Moderate.
69----------------- Letcher	D	None---------	---	---	3.5-6.0	Perched	Nov-Jun	>60	---	Moderate	High------	Moderate.
70----------------- Svea	B	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High------	Low.
71*:												
Svea--------------	B	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High------	Low.
Cresbard----------	C	None---------	---	---	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High------	Moderate.
72----------------- Swenoda	B	None---------	---	---	2.5-4.0	Perched	Mar-Jun	>60	---	Moderate	High------	Moderate.
73*:												
Swenoda-----------	B	None---------	---	---	2.5-4.0	Perched	Mar-Jun	>60	---	Moderate	High------	Moderate.
Letcher-----------	D	None---------	---	---	3.5-6.0	Perched	Nov-Jun	>60	---	Moderate	High------	Moderate.
74*:												
Swenoda-----------	B	None---------	---	---	2.5-4.0	Perched	Mar-Jun	>60	---	Moderate	High------	Moderate.
Barnes------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
77----------------- Towner	B	None---------	---	---	3.0-6.0	Perched	Apr-Jun	>60	---	Moderate	High------	Low.
78----------------- Ulen	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	Moderate	Low-------	Low.
79*:												
Ulen--------------	B	None---------	---	---	2.5-6.0	Apparent	Apr-Jul	>60	---	Moderate	Low-------	Low.

See footnote at end of table

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
79*:												
Hamar	A/D	None	---	---	0.5-2.0	Apparent	Oct-Jun	>60	---	Moderate	High	Low.
80*, 81B*:												
Makoti	B	None	---	---	5.0-6.0	Apparent	Sep-Jun	>60	---	Moderate	High	Low.
Sakakawea	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
85B*:												
Lehr	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Wabek	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
86E Wabek	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
90 Vallers	C	None	---	---	1.0-2.5	Apparent	Nov-Jun	>60	---	High	High	Low.
91B Ruso	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
92B*:												
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Bowbells	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
93C*:												
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Zahl	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
94C Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
95B*:												
Bowbells	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Zahl	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
96E*:												
Zahl	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
97F*:												
Zahl--------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Max---------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
98D*:												
Williams----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Zahl--------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Parnell-----------	C/D	None---------	---	---	+2-2.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. NP means nonplastic. The pedons are typical for the series in the survey area. For the location of the pedons, see "Soil Series and Their Morphology")

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve--					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
											Pct		Lb/cu ft	Pct
Brantford loam: (S86ND021-092)														
2C2-- 33 to 60	A-1-b(0)	SP-SM	87	74	58	33	9	---	3	---	---	NP	119	13
Cavour loam: (S86ND021-136)														
Bt1-- 12 to 19	A-6(9)	CL	100	100	100	90	59	---	23	---	36	20	123	11
Czg-- 31 to 60	A-7-6(15)	CL	100	100	100	93	70	---	37	---	41	25	123	11
Coe loam: (S86ND021-091)														
C1---- 6 to 17	A-2-7(1)	SM	92	76	55	42	29	---	9	---	52	14	85	27
C2--- 17 to 33	A-2-6(0)	SM	82	66	49	28	15	---	6	---	39	13	91	24
Cresbard loam: (S86ND021-077)														
Bt1-- 12 to 19	A-7-6(14)	CL	100	100	100	95	69	---	37	---	40	24	118	13
C---- 34 to 60	A-6(12)	CL	98	97	96	89	65	---	30	---	37	23	126	10
Embden fine sandy loam: (S85ND021-106)														
Bw1-- 10 to 20	A-2-4(0)	SM	100	100	100	95	26	---	10	---	---	NP	126	10
C---- 47 to 60	A-2-4(0)	SM	100	100	100	93	25	---	10	---	---	NP	126	10
Max loam: (S86ND021-128)														
Bw2-- 12 to 17	A-6(7)	CL	100	100	98	92	60	---	24	---	35	15	118	13
C---- 32 to 60	A-6(5)	CL	99	97	93	87	60	---	21	---	32	12	121	12
Miranda loam: (S86ND021-085)														
Btz--- 8 to 15	A-7-6(13)	CL	100	100	100	91	56	---	35	---	46	30	120	13
Cz--- 27 to 60	A-7-6(25)	CL	100	100	99	94	77	---	48	---	50	34	122	12

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve--					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
											Pct		Lb/cu ft	Pct
Renshaw loam: (S86ND021-114)														
2C--- 16 to 30	A-2-4(0)	SW-SM	77	63	47	24	12	---	5	---	32	8	132	8
2C--- 35 to 60	A-1-a(0)	SW-SM	82	64	44	20	9	---	3	---	25	5	134	8
Sioux loam: (S86ND021-113)														
2C--- 10 to 30	A-1-a(0)	SP-SM	79	66	49	31	9	---	2	---	---	NP	131	8
Spottswood loam: (S86ND021-141)														
Bw1--- 9 to 17	A-6(7)	CL	98	97	92	81	51	---	25	---	38	20	120	12
2C2-- 34 to 60	A-2-6(0)	SC	85	71	54	39	22	---	10	---	30	15	130	9
Wabek loam: (S86ND021-142)														
2C1--- 4 to 14	A-1-b(0)	SW-SM	87	72	54	18	6	---	2	---	---	NP	126	10
2C2-- 14 to 60	A-1-b(0)	SW-SM	83	74	63	19	6	---	1	---	---	NP	126	10
Wyard loam: (S86ND021-103)														
Bw--- 19 to 23	A-7-6(18)	CL	100	100	100	98	82	---	33	---	41	23	111	15
C---- 34 to 60	A-4(0)	CL-ML	99	97	92	84	51	---	15	---	24	6	127	10
Zahl loam: (S86ND021-144)														
C---- 20 to 30	A-4(4)	CL	100	100	97	90	60	---	20	---	28	10	122	12
C---- 35 to 60	A-4(2)	CL	100	100	100	93	56	---	18	---	25	8	124	11

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Aberdeen	Fine, montmorillonitic Glossic Udic Natriborolls
Arvilla	Sandy, mixed Udic Haploborolls
Barnes	Fine-loamy, mixed Udic Haploborolls
Bearden	Fine-silty, frigid Aeric Calciaquolls
Bowbells	Fine-loamy, mixed Pachic Argiborolls
Brantford	Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls
Buse	Fine-loamy, mixed Udorthentic Haploborolls
Cavour	Fine, montmorillonitic Udic Natriborolls
Clontarf	Coarse-loamy, mixed Pachic Udic Haploborolls
Coe	Sandy-skeletal, mixed Udorthentic Haploborolls
Colvin	Fine-silty, frigid Typic Calciaquolls
Cresbard	Fine, montmorillonitic Glossic Udic Natriborolls
Divide	Fine-loamy over sandy or sandy-skeletal, frigid Aeric Calciaquolls
Eckman	Coarse-silty, mixed Udic Haploborolls
Edgeley	Fine-loamy, mixed Udic Haploborolls
Embden	Coarse-loamy, mixed Pachic Udic Haploborolls
Exline	Fine, montmorillonitic Leptic Natriborolls
Fordville	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Forman	Fine-loamy, mixed Udic Argiborolls
Gardena	Coarse-silty, mixed Pachic Udic Haploborolls
Glyndon	Coarse-silty, frigid Aeric Calciaquolls
Hamar	Sandy, mixed, frigid Typic Haplaquolls
Hamerly	Fine-loamy, frigid Aeric Calciaquolls
Harriet	Fine, montmorillonitic, frigid Typic Natraquolls
Hecla	Sandy, mixed Aquic Haploborolls
Kratka	Sandy over loamy, mixed, frigid Typic Haplaquolls
Lamoure	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
La Prairie	Fine-loamy, mixed Cumulic Udic Haploborolls
Lehr	Fine-loamy over sandy or sandy-skeletal, mixed Typic Haploborolls
Letcher	Coarse-loamy, mixed Udic Natriborolls
Ludden	Fine, montmorillonitic (calcareous), frigid Vertic Haplaquolls
Maddock	Sandy, mixed Udorthentic Haploborolls
Makoti	Fine-silty, mixed Pachic Haploborolls
Max	Fine-loamy, mixed Typic Haploborolls
Miranda	Fine-loamy, mixed Leptic Natriborolls
Overly	Fine-silty, mixed Pachic Udic Haploborolls
Parnell	Fine, montmorillonitic, frigid Typic Argiaquolls
Renshaw	Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls
Rosewood	Sandy, frigid Typic Calciaquolls
Ruso	Coarse-loamy, mixed Pachic Haploborolls
Ryan	Fine, montmorillonitic, frigid Typic Natraquolls
Sakakawea	Coarse-silty, mixed Typic Calciborolls
Serden	Mixed, frigid Typic Udipsamments
Sinai	Fine, montmorillonitic Udertic Haploborolls
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Southam	Fine, montmorillonitic (calcareous), frigid Cumulic Haplaquolls
Spottswood	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Stirum	Coarse-loamy, mixed, frigid Typic Natraquolls
Svea	Fine-loamy, mixed Pachic Udic Haploborolls
Swenoda	Coarse-loamy, mixed Pachic Udic Haploborolls
Tiffany	Coarse-loamy, mixed, frigid Typic Haplaquolls
Tonka	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Towner	Sandy over loamy, mixed Udorthentic Haploborolls
Ulen	Sandy, frigid Aeric Calciaquolls
Vallers	Fine-loamy, frigid Typic Calciaquolls
Vang	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Wabek	Sandy-skeletal, mixed Entic Haploborolls
Williams	Fine-loamy, mixed Typic Argiborolls
Wyard	Fine-loamy, mixed, frigid Typic Haplaquolls
Wyndmere	Coarse-loamy, frigid Aeric Calciaquolls
Zahl	Fine-loamy, mixed Entic Haploborolls

*U.S. G.P.O.:1993-341-646:80503/SCS

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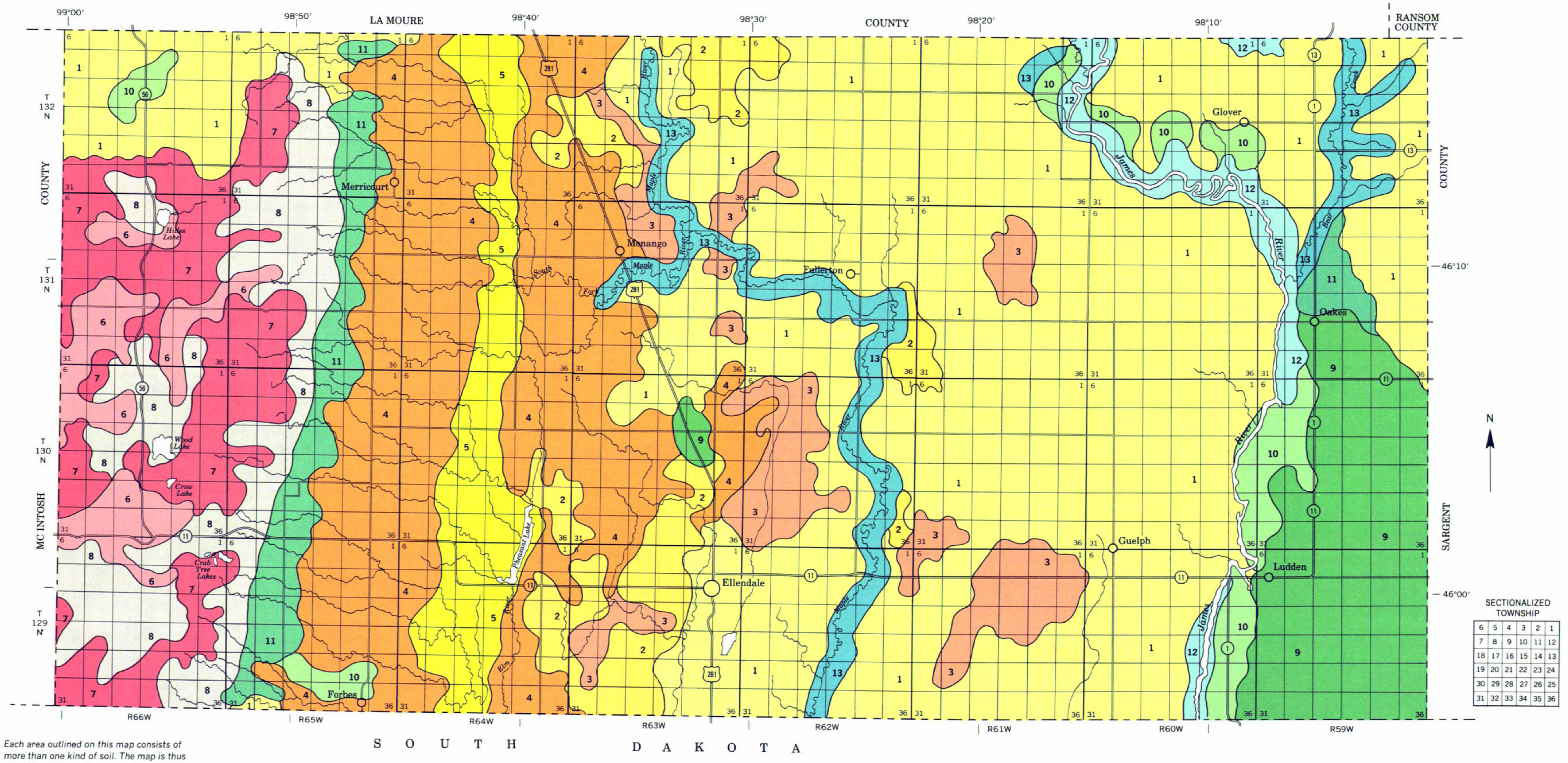


Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SOIL LEGEND*

DOMINANTLY LEVEL TO HILLY, LOAMY SOILS ON TILL PLAINS, MORAINES, AND OUTWASH PLAINS

- 1 — BARNES-SVEA-HAMERLY ASSOCIATION: Deep, level to hilly, well drained to somewhat poorly drained, medium textured soils
- 2 — SWENODA-BARNES-LETCHER ASSOCIATION: Deep, level and nearly level, well drained to somewhat poorly drained, moderately coarse textured and medium textured soils
- 3 — BARNES-CRESBARD-HAMERLY ASSOCIATION: Deep, level to undulating, well drained to somewhat poorly drained, medium textured soils
- 4 — CAVOUR-BARNES ASSOCIATION: Deep, level to undulating, well drained, medium textured soils
- 5 — EDGELEY-BRANTFORD-CAVOUR ASSOCIATION: Moderately deep and deep, nearly level and undulating, well drained, medium textured soils

DOMINANTLY NEARLY LEVEL TO VERY STEEP, LOAMY SOILS ON OUTWASH PLAINS, TILL PLAINS, AND MORAINES

- 6 — WABEK-LEHR-ZAHL ASSOCIATION: Deep, nearly level to hilly, excessively drained to well drained, medium textured soils
- 7 — WILLIAMS-BOWBELLS-ZAHL ASSOCIATION: Deep, nearly level to very steep, well drained and moderately well drained, medium textured soils
- 8 — ZAHL-WILLIAMS ASSOCIATION: Deep, nearly level to very steep, well drained, medium textured soils

DOMINANTLY LEVEL TO ROLLING, SANDY, SILTY, AND LOAMY SOILS ON OUTWASH PLAINS AND LAKE PLAINS

- 9 — HECLA-ULEN-HAMAR ASSOCIATION: Deep, level and nearly level, moderately well drained to poorly drained, coarse textured and moderately coarse textured soils
- 10 — GARDENA-GLYNDON-OVERLY ASSOCIATION: Deep, level to undulating, moderately well drained and somewhat poorly drained, medium textured soils
- 11 — SPOTTSWOOD-RENSHAW-SIOUX ASSOCIATION: Deep, level to rolling, moderately well drained, somewhat excessively drained, and excessively drained, medium textured soils

DOMINANTLY LEVEL, LOAMY AND CLAYEY SOILS ON FLOOD PLAINS AND TERRACES

- 12 — LAMOURE-LUDDEN-RYAN ASSOCIATION: Deep, level, poorly drained, medium textured and fine textured soils
- 13 — LA PRAIRIE-RENSHAW ASSOCIATION: Deep, level, moderately well drained and somewhat excessively drained, medium textured soils

* The texture terms in the descriptive headings refer to the surface layer of the major soils in each association.

Compiled 1989

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION
NORTH DAKOTA COOPERATIVE EXTENSION SERVICE
NORTH DAKOTA STATE SOIL CONSERVATION COMMITTEE

GENERAL SOIL MAP

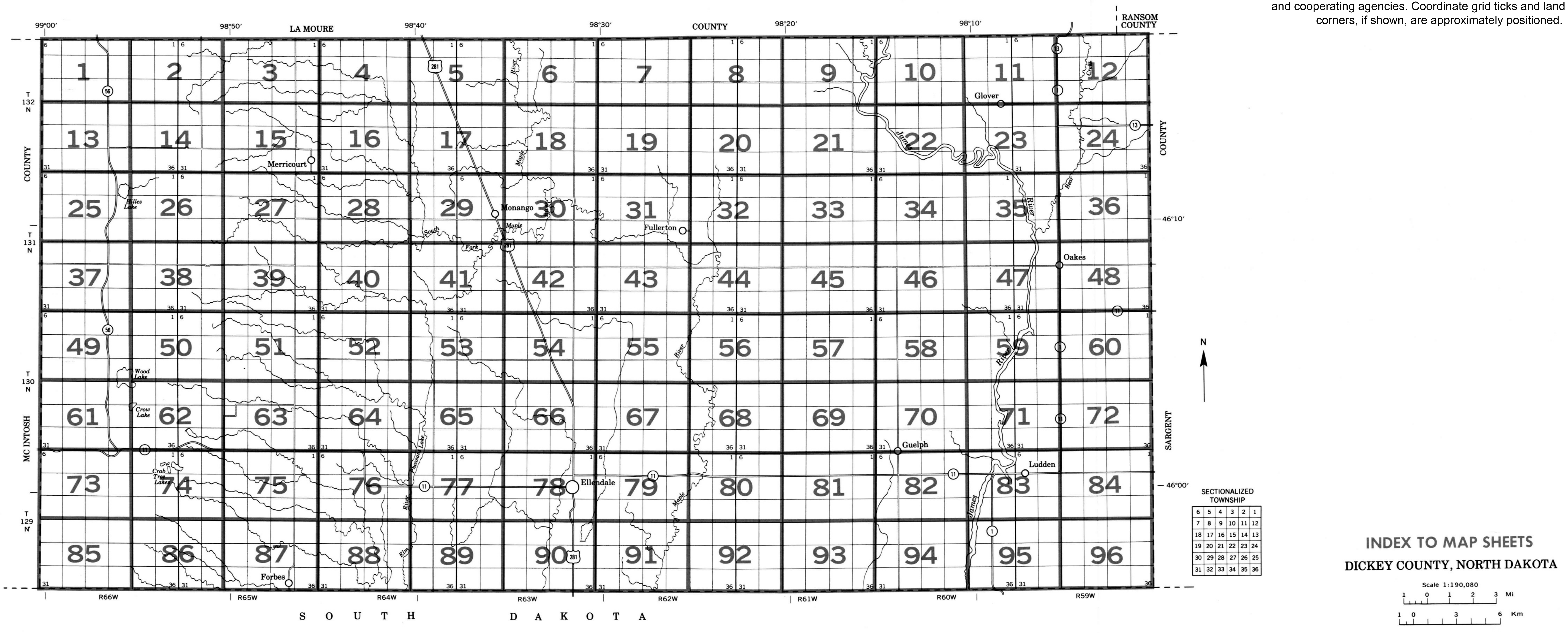
DICKEY COUNTY, NORTH DAKOTA

Scale 1:190,080

1 0 1 2 3 Mi

1 0 3 6 Km

Original text from each individual map sheet read:
This soil survey map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SOIL LEGEND

Symbols consist of numbers or a combination of numbers and a letter. The number designates the soil type, and the letter designates the slope class. Symbols without a slope letter are for level or nearly level soils or for miscellaneous areas. Soil names without a slope designation are for level soils.

SYMBOL	NAME
2	Overly-Aberdeen silt loams
3	Aberdeen-Exline silt loams
4	Rosewood fine sandy loam
6	Parnell silty clay loam
7	Southam silt loam
8	Tonka silt loam
9	Bearden silt loam
10	Glyndon silt loam, saline
12B	Arvilla fine sandy loam, 1 to 6 percent slopes
13	Rosewood fine sandy loam, wet
14	Barnes-Gardena loams, 1 to 3 percent slopes
15	Barnes-Svea loams, 1 to 3 percent slopes
15B	Barnes-Svea loams, 3 to 6 percent slopes
16B	Barnes-Cresbard loams, 2 to 6 percent slopes
17B	Barnes-Buse loams, 3 to 6 percent slopes
17C	Barnes-Buse loams, 6 to 9 percent slopes
18B	Barnes-Cavour loams, 1 to 6 percent slopes
19E	Buse-Barnes loams, 9 to 25 percent slopes
21	Cavour-Miranda loams, 1 to 3 percent slopes
22	Colvin silt loam
23	Colvin silt loam, wet
24	Gardena loam, 0 to 3 percent slopes
25	Divide loam, 0 to 2 percent slopes
26B	Eckman-Gardena silt loams, 3 to 6 percent slopes
27B	Embden sandy loam, 1 to 6 percent slopes
28B	Clontarf fine sandy loam, 1 to 6 percent slopes
29	Glyndon silt loam, 0 to 3 percent slopes
31	Edgeley loam, 1 to 3 percent slopes
31B	Edgeley loam, 3 to 6 percent slopes
33	Hecla loamy fine sand, 0 to 3 percent slopes
34	Hecla-Hamar loamy fine sands, 0 to 3 percent slopes
35	Fordville loam, 1 to 3 percent slopes
36	Hecla-Ulen complex, 0 to 3 percent slopes
37	Forman-Cavour loams, 1 to 3 percent slopes
38	Miranda-Cavour loams, 1 to 3 percent slopes
39	Hamar loamy fine sand
40	Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes
41	Colvin silt loam, saline
42	Hamerly-Wyard loams, 0 to 3 percent slopes
43	Exline silt loam
44	Harriet loam
46	Ludden clay

SYMBOL	NAME
47	La Prairie loam, channeled
48	La Prairie loam
49	Lamoure silt loam
50	Wyndmere-Tiffany fine sandy loams
51	Kratka-Letcher fine sandy loams, 0 to 2 percent slopes
52C	Brantford-Coe loams, 3 to 9 percent slopes
53	Brantford-Vang loams, 1 to 3 percent slopes
54	Maddock fine sandy loam, 1 to 3 percent slopes
56	Overly silt loam
57	Ryan-Ludden complex
58	Renshaw loam
59	Pits
60B	Renshaw-Sioux loams, 1 to 6 percent slopes
61D	Sioux loam, 1 to 15 percent slopes
62C	Sioux-Barnes loams, 3 to 9 percent slopes
64	Sinai silty clay, 0 to 2 percent slopes
65B	Serden-Hamar complex, 0 to 6 percent slopes
66	Spottswood loam, 1 to 3 percent slopes
67	Stirum fine sandy loam
68	Stirum-Letcher fine sandy loams
69	Letcher fine sandy loam
70	Svea loam
71	Svea-Cresbard loams, 0 to 2 percent slopes
72	Swenoda fine sandy loam, 1 to 3 percent slopes
73	Swenoda-Letcher fine sandy loams, 1 to 3 percent slopes
74	Swenoda-Barnes complex, 1 to 3 percent slopes
77	Towner loamy fine sand, 0 to 3 percent slopes
78	Ulen fine sandy loam
79	Ulen-Hamar complex
80	Makoti-Sakakawea silt loams, 1 to 3 percent slopes
81B	Makoti-Sakakawea silt loams, 3 to 6 percent slopes
85B	Lehr-Wabek loams, 1 to 6 percent slopes
86E	Wabek loam, 6 to 25 percent slopes
90	Vallers loam
91B	Ruso sandy loam, 1 to 6 percent slopes
92B	Williams-Bowbells loams, 3 to 6 percent slopes
93C	Williams-Zahl loams, 6 to 9 percent slopes
94C	Williams loam, 3 to 9 percent slopes, very stony
95B	Bowbells-Zahl loams, 3 to 6 percent slopes
96E	Zahl-Williams loams, 6 to 25 percent slopes
97F	Zahl-Max loams, 15 to 45 percent slopes
98D	Williams-Zahl-Parnell complex, 0 to 15 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state, or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 173
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small — water

PITS — w

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 74; 77

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

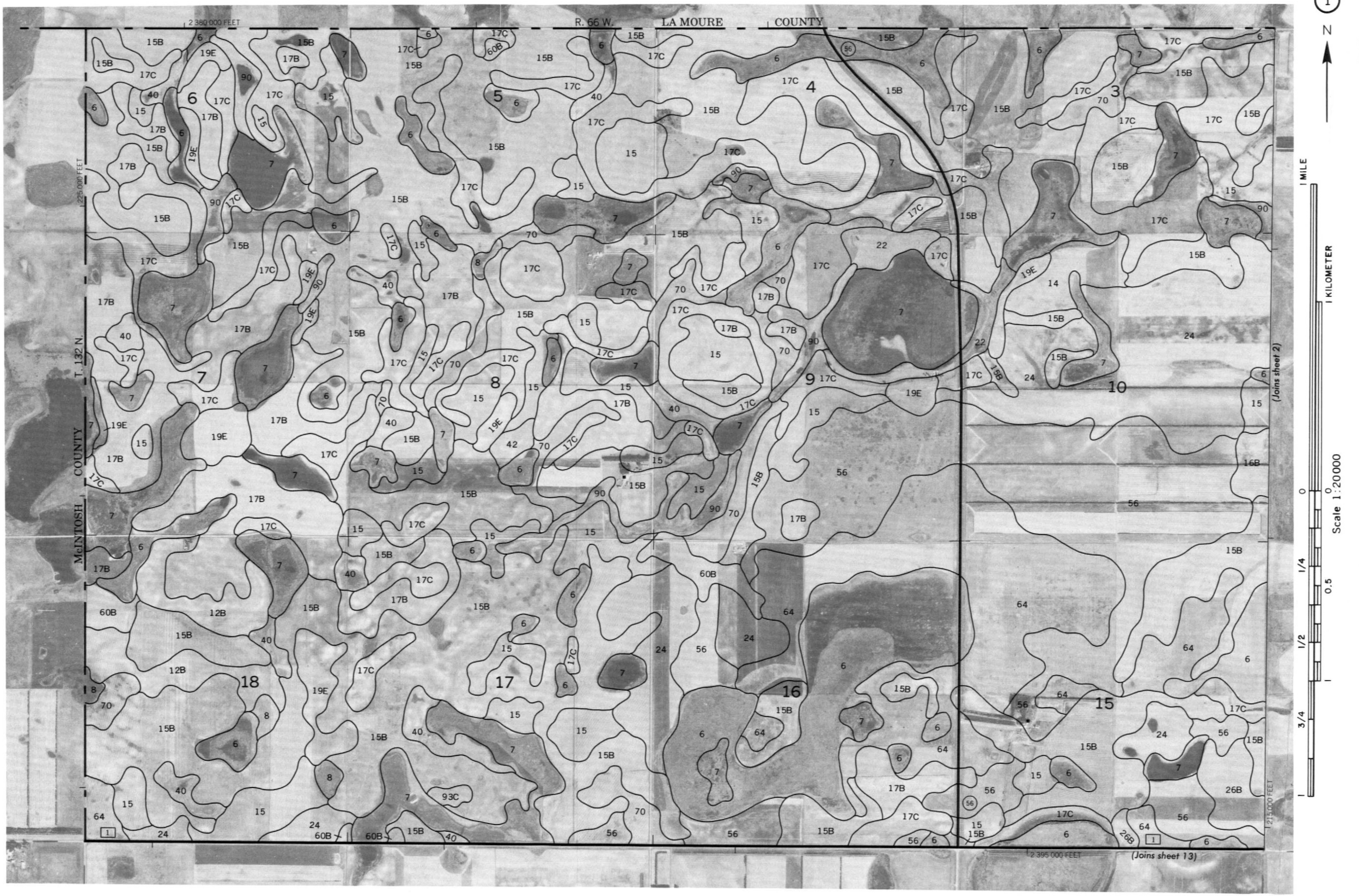
SOIL SAMPLE (normally not shown) — S

MISCELLANEOUS

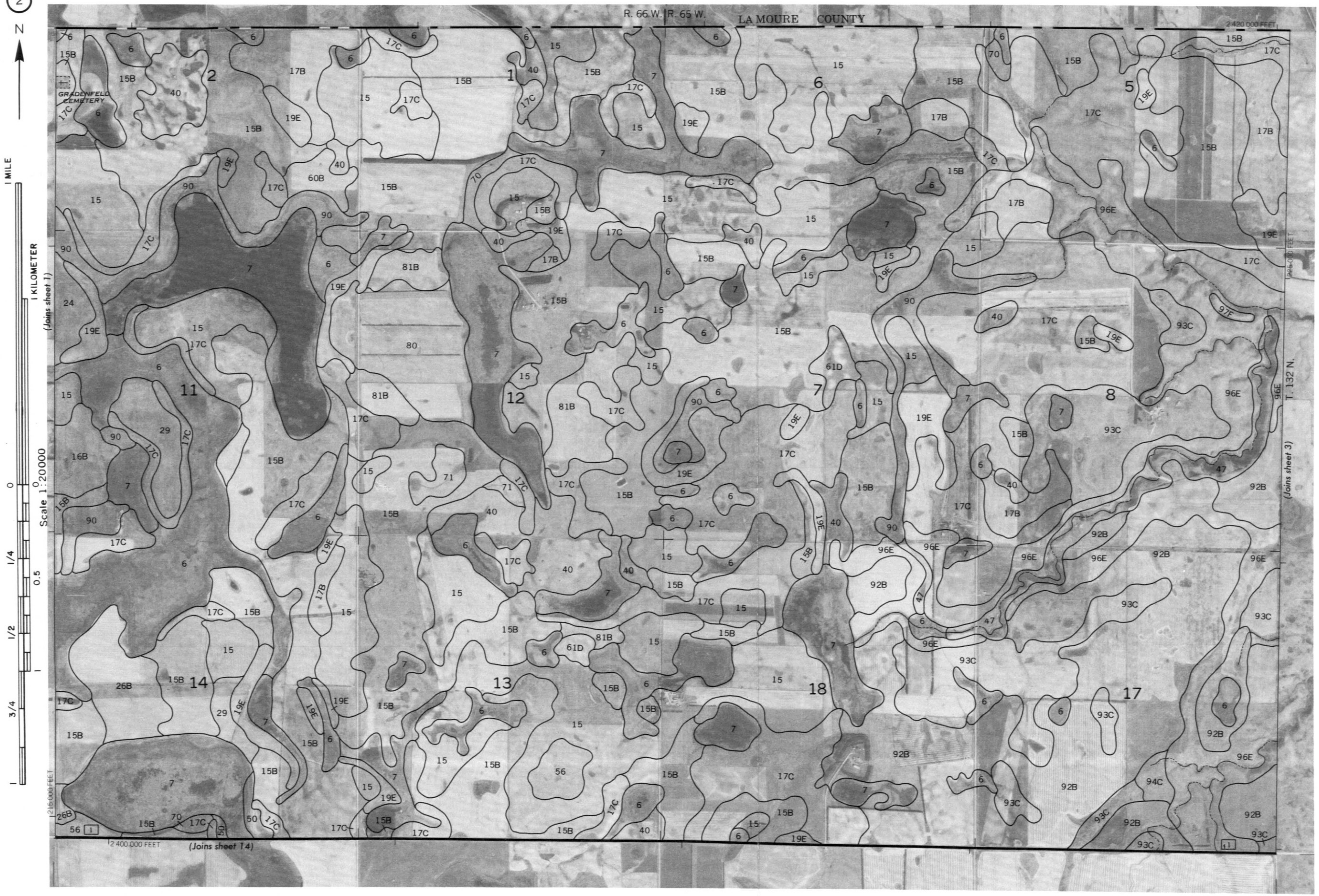
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

(1 to 3 acres)

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 1



SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 2



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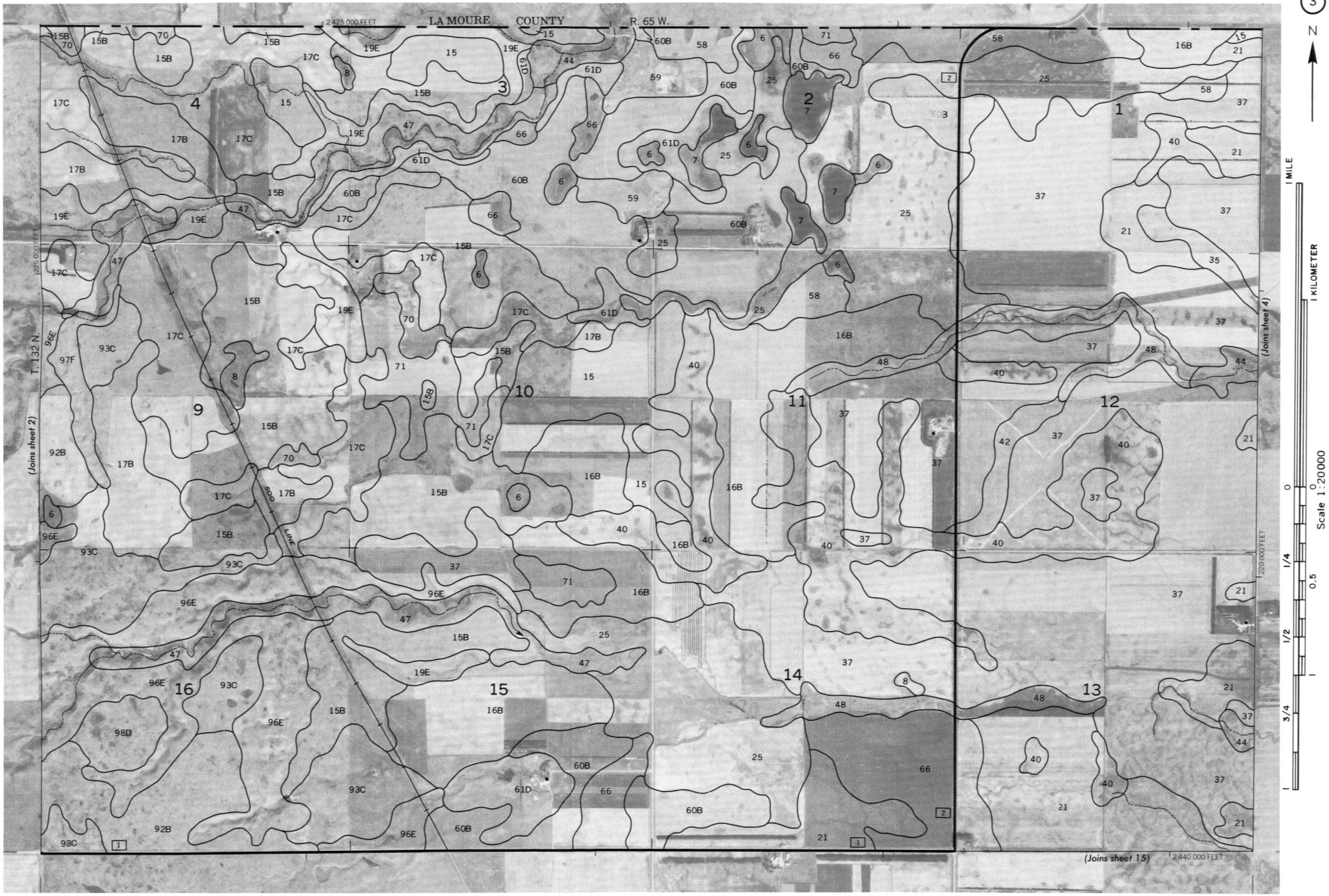

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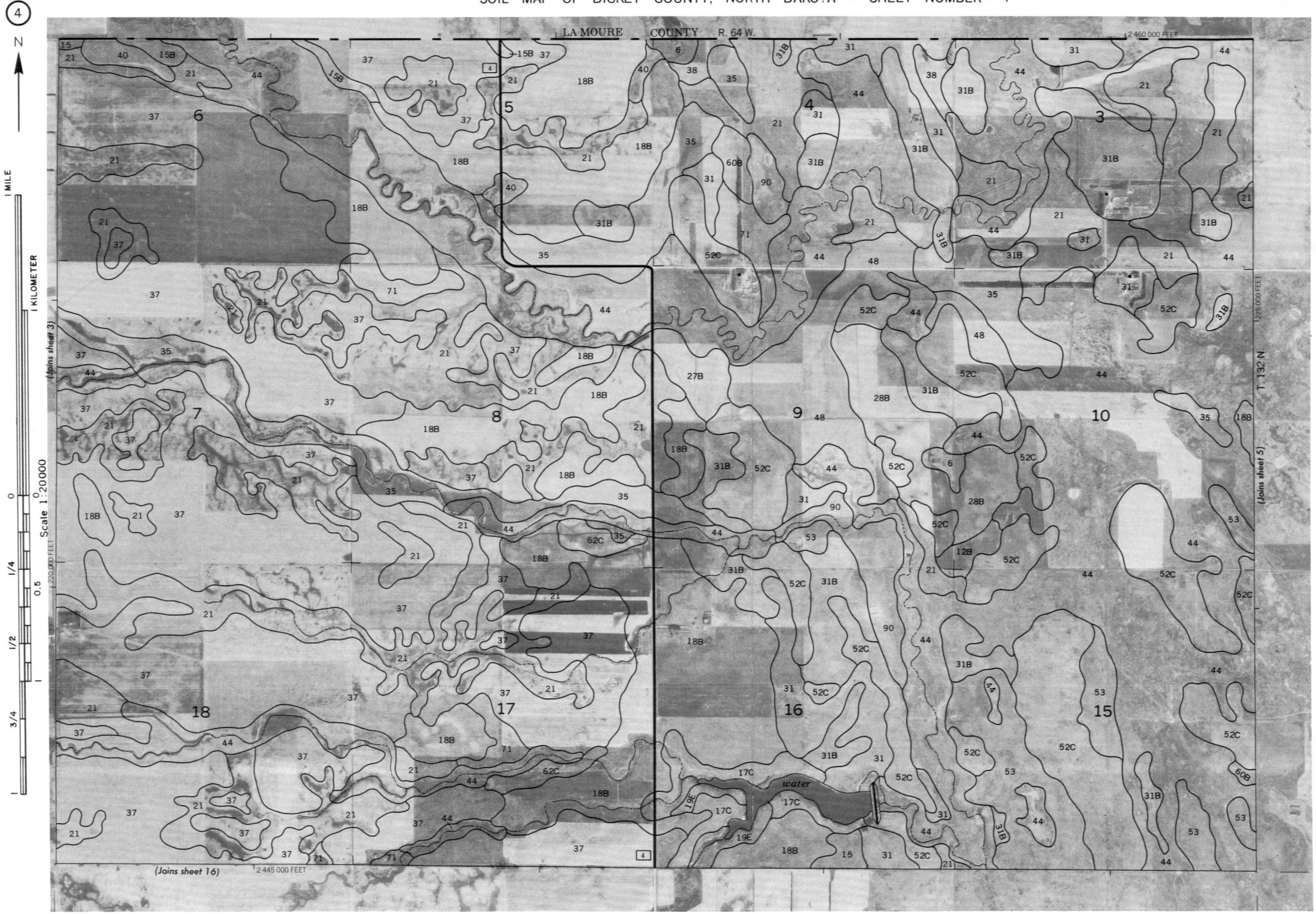
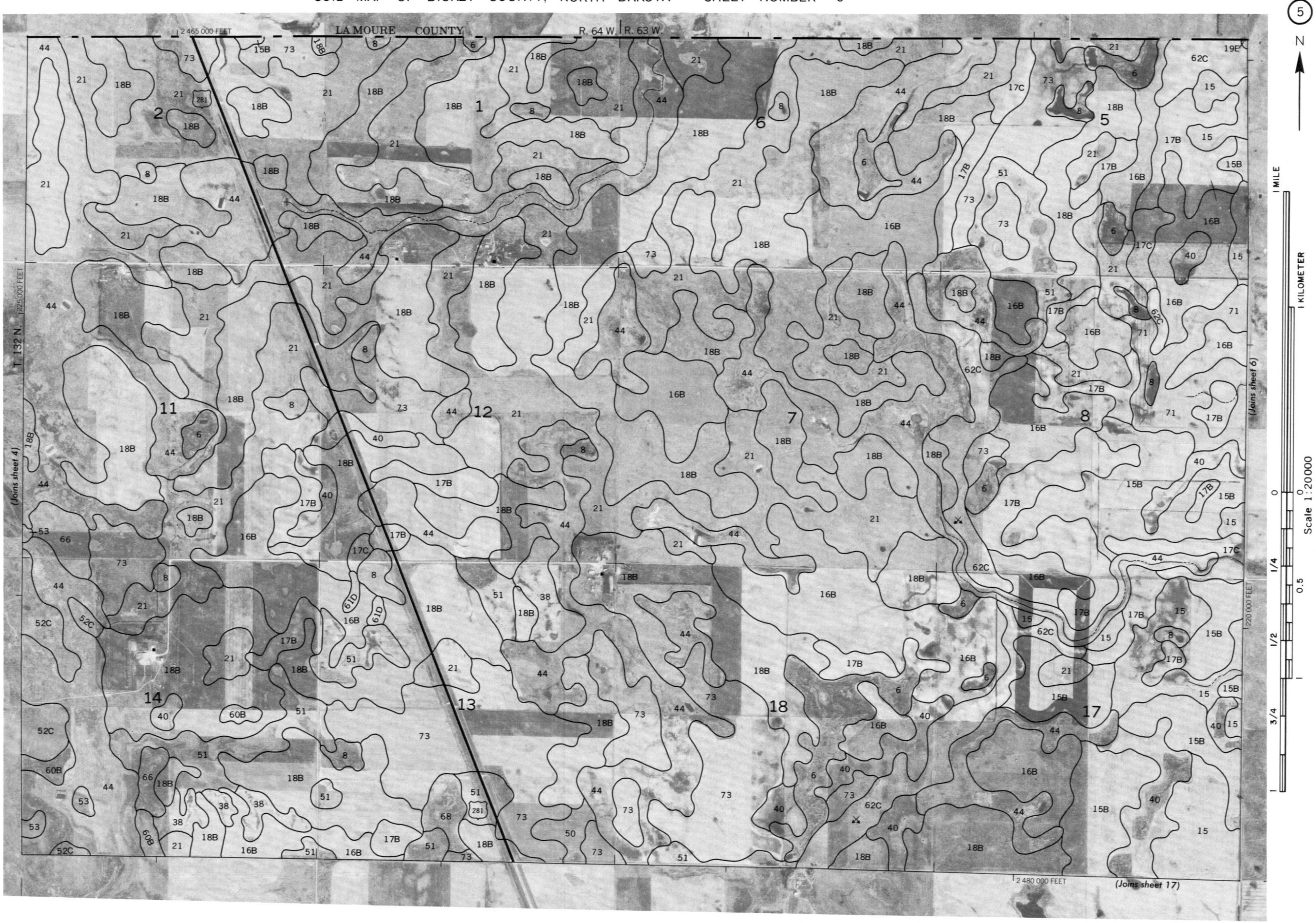


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 5



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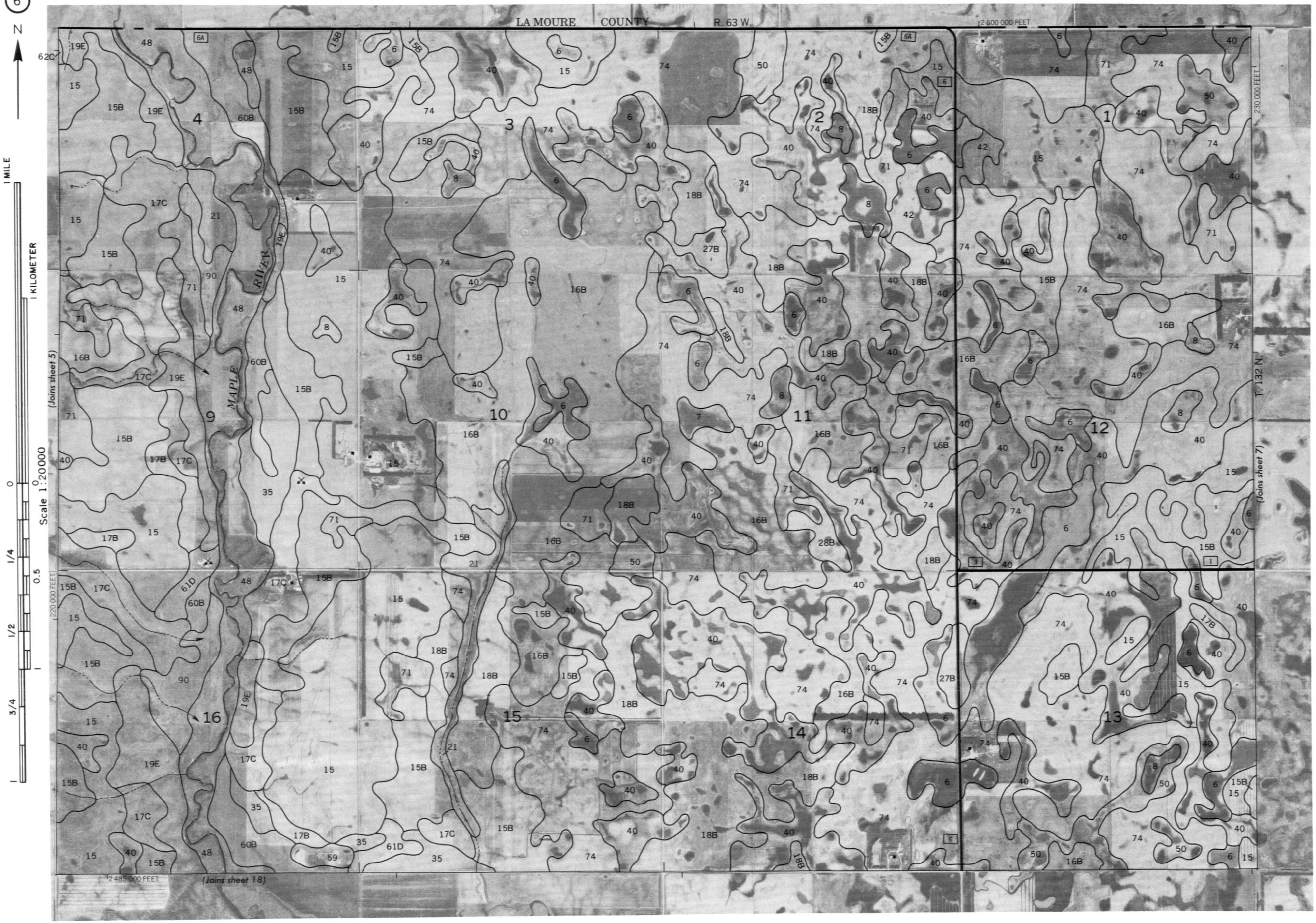

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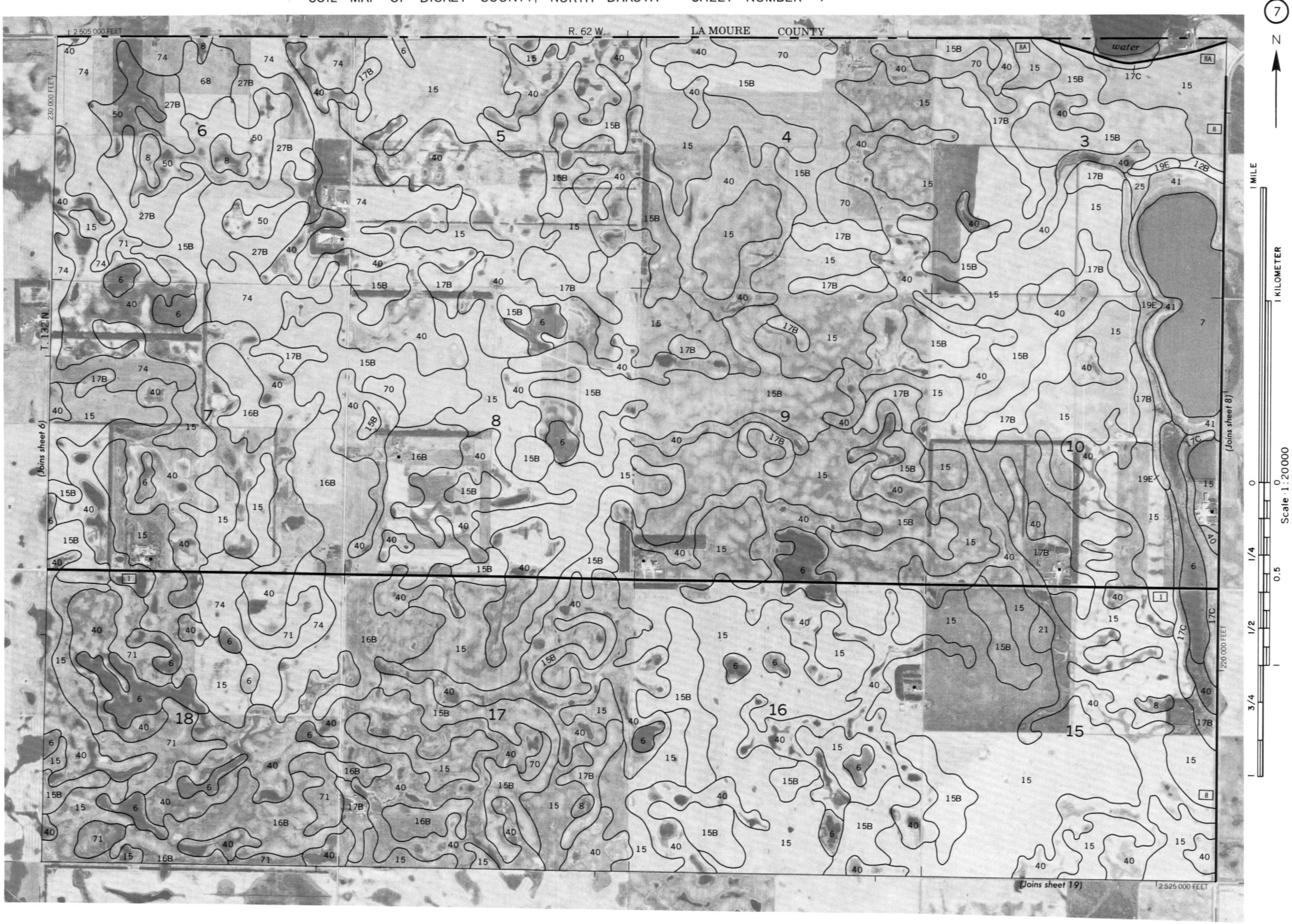
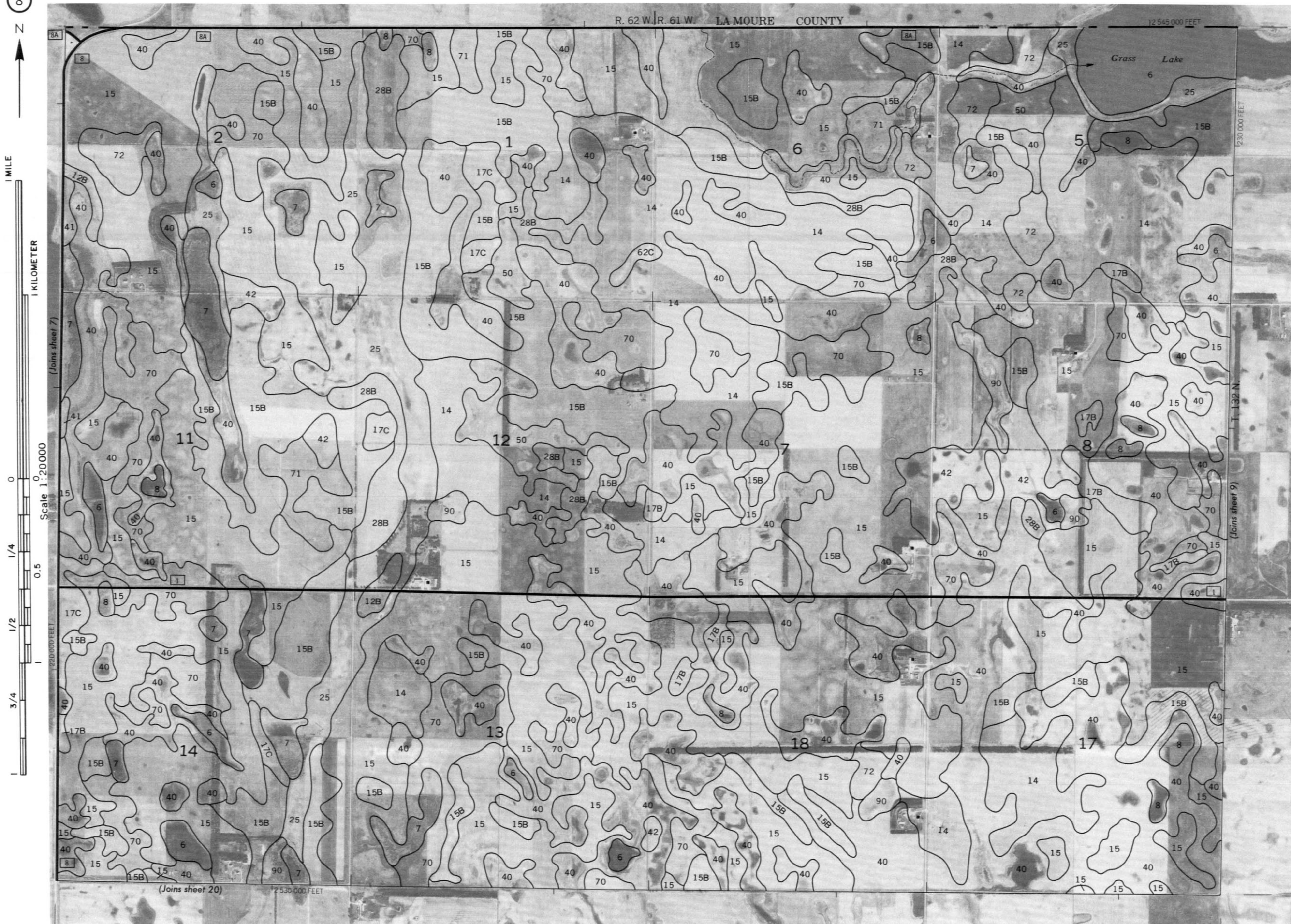
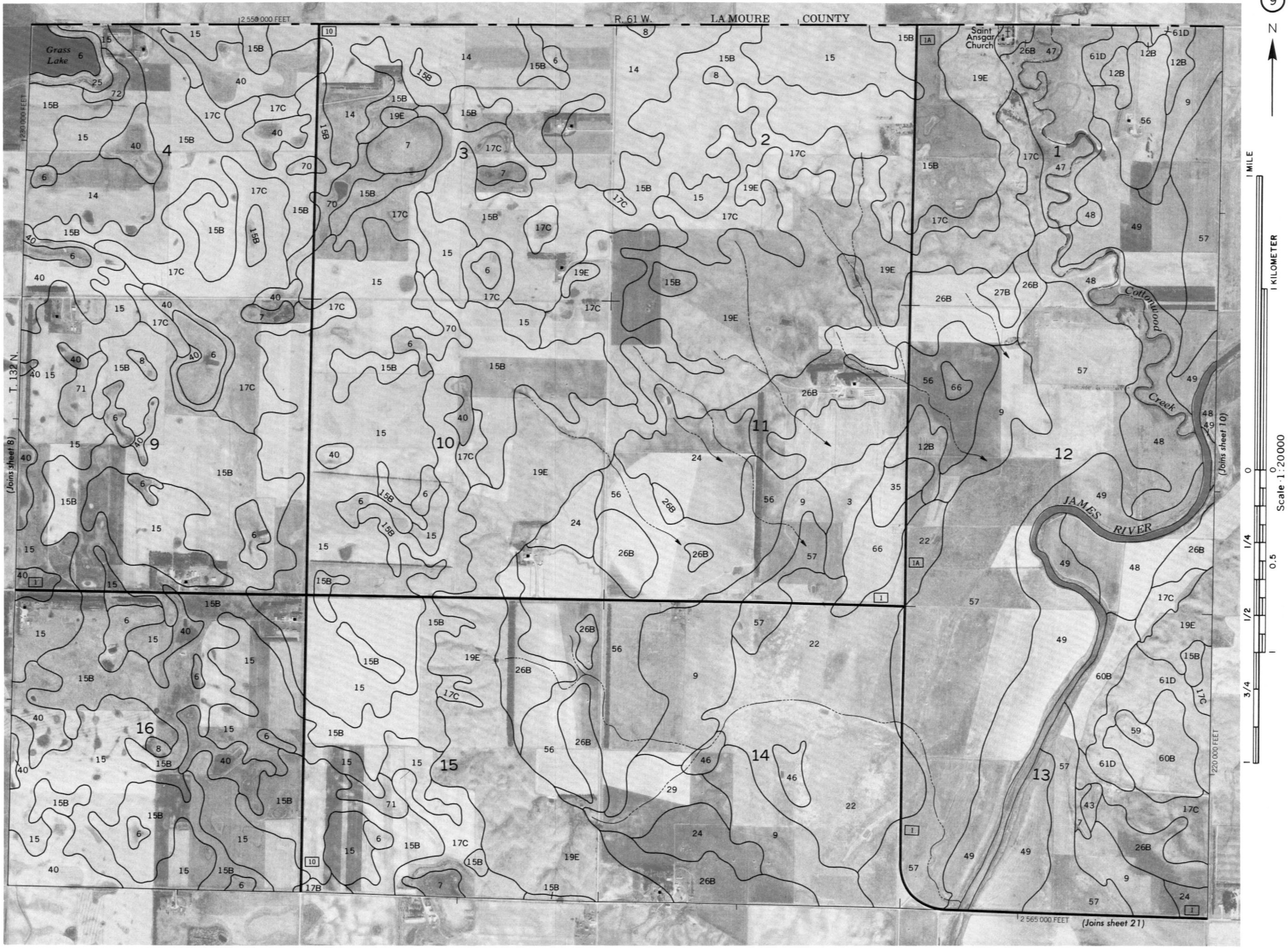
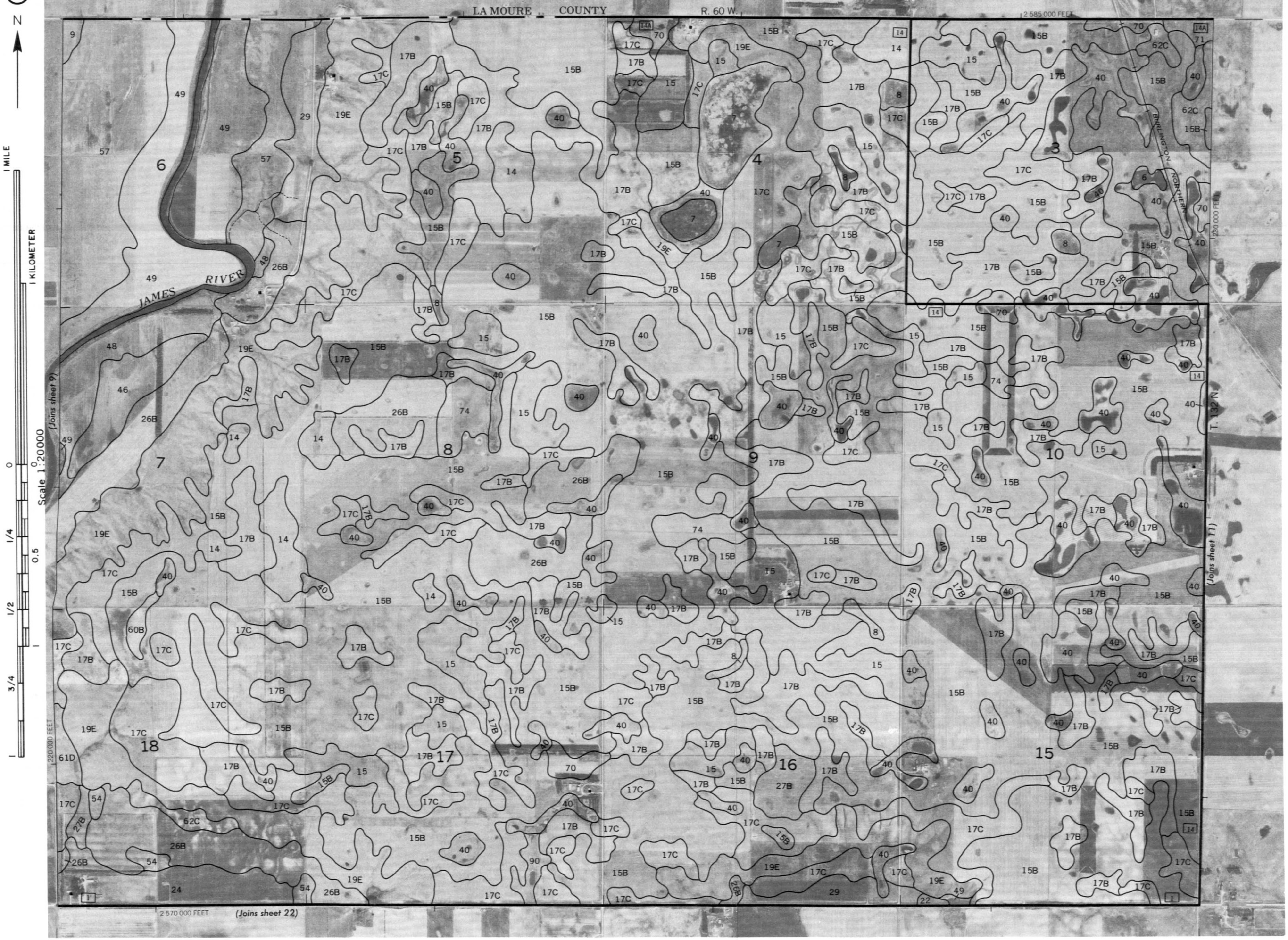


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 8



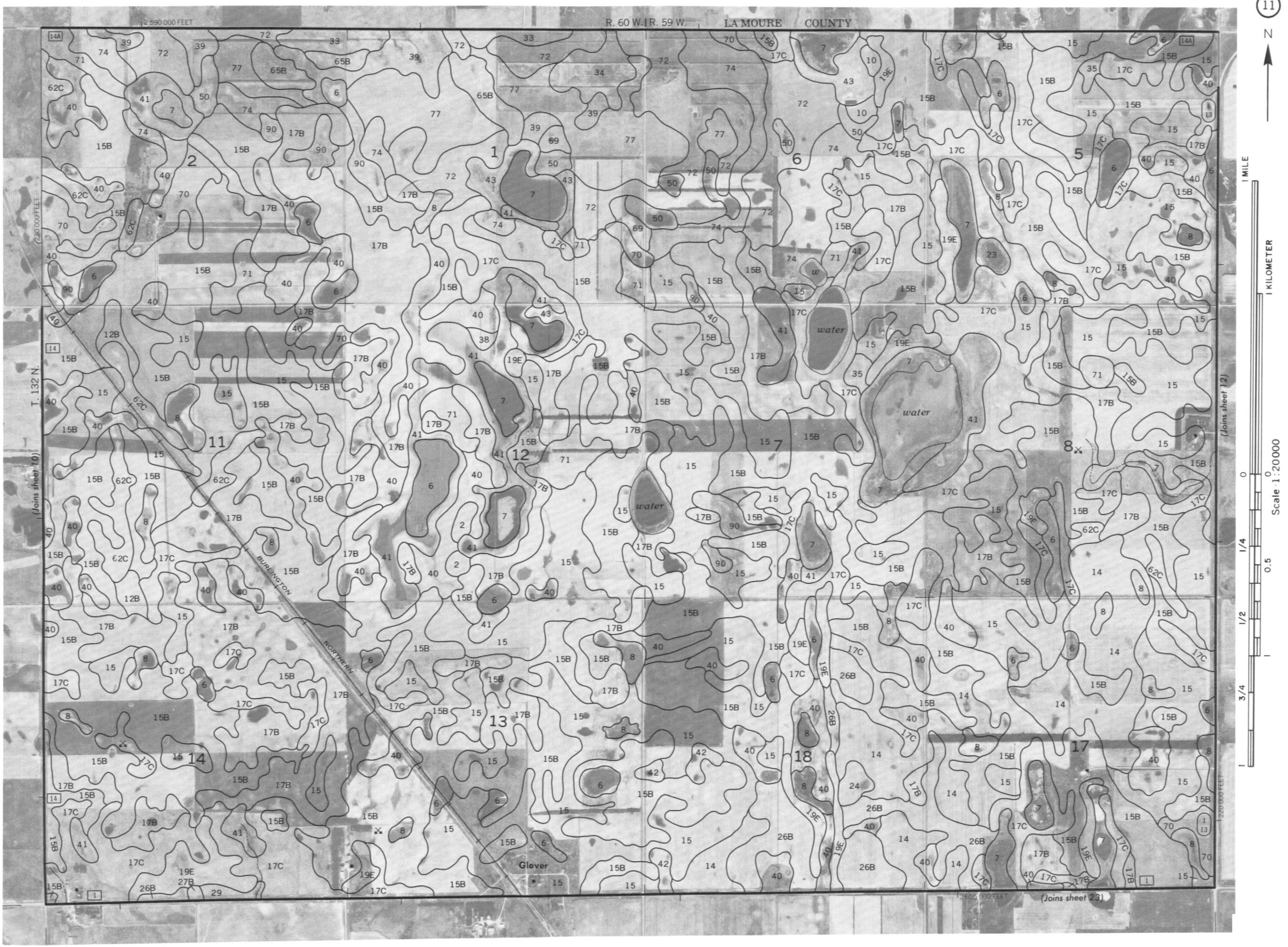

9
N
LA MOURE COUNTY
R. 61 W.
T. 132 N.
Grass Lake
Saint Ansgar Church
Cottonwood Creek
JAMES RIVER
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 21)
2 550 000 FEET
2 565 000 FEET
220 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 10



SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 11

11

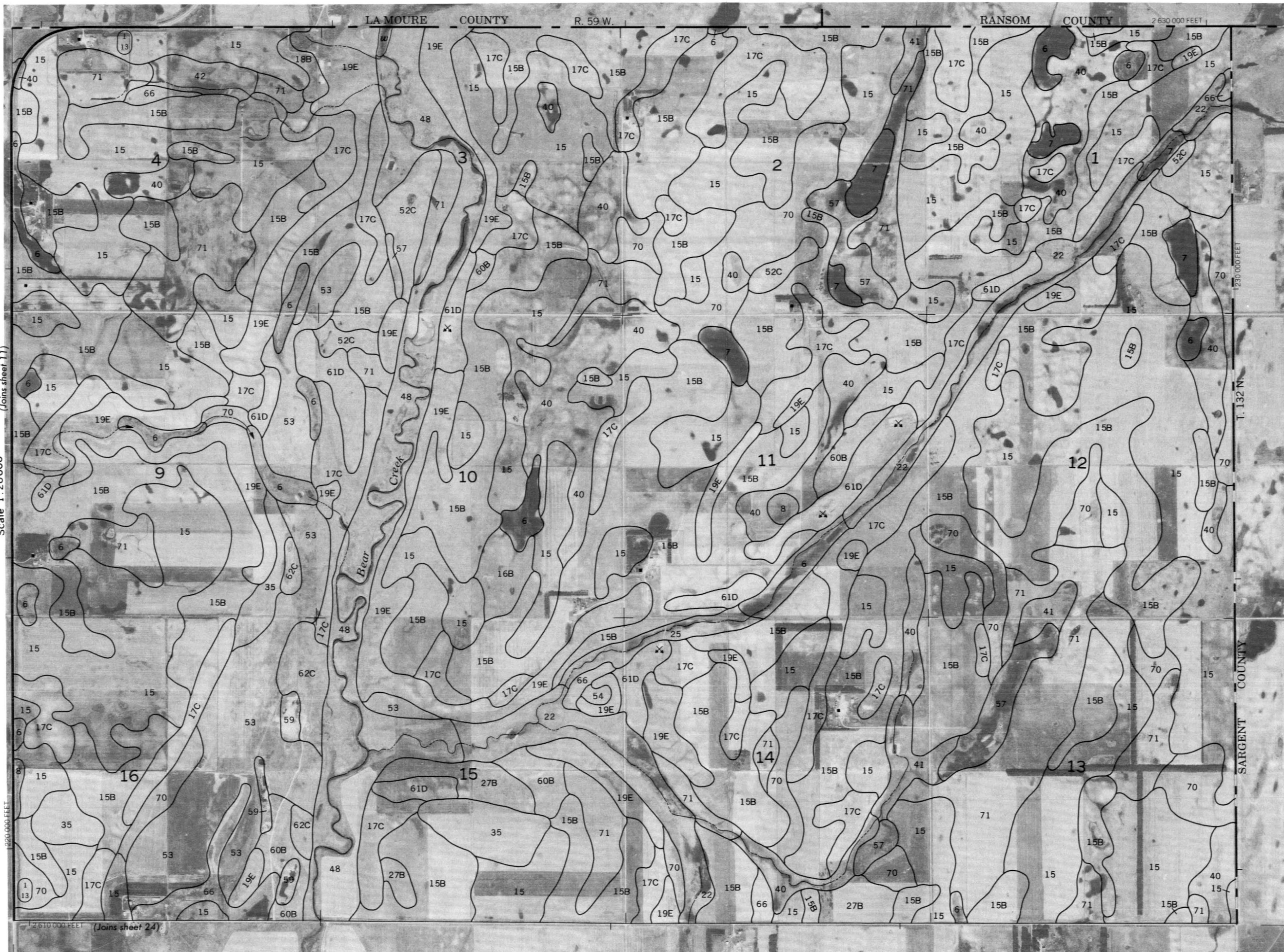


12

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 12

N

1 MILE
1 KILOMETER
Scale 1:20000
0 0
1/4 0.5
1/2
3/4 1
1



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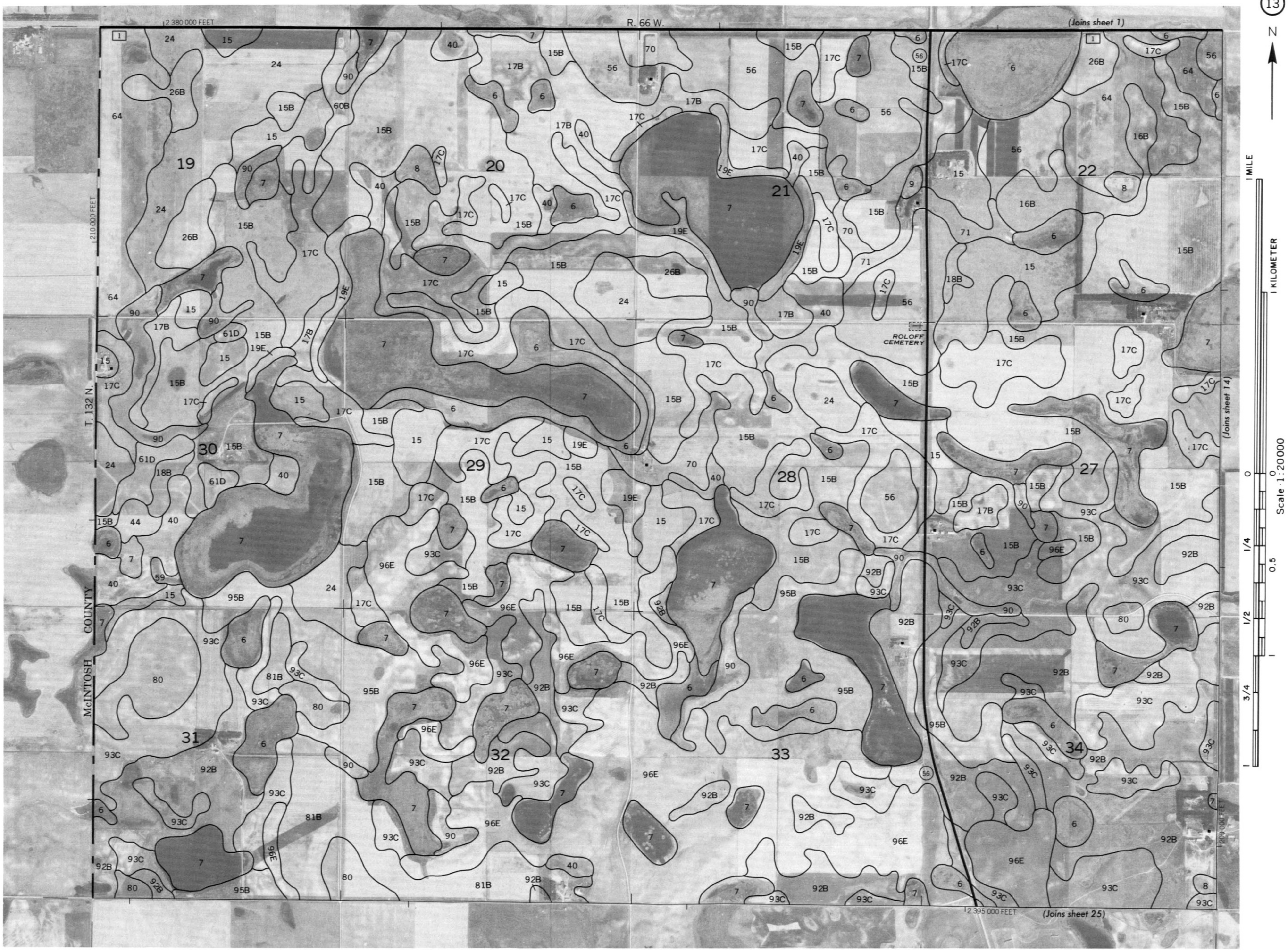
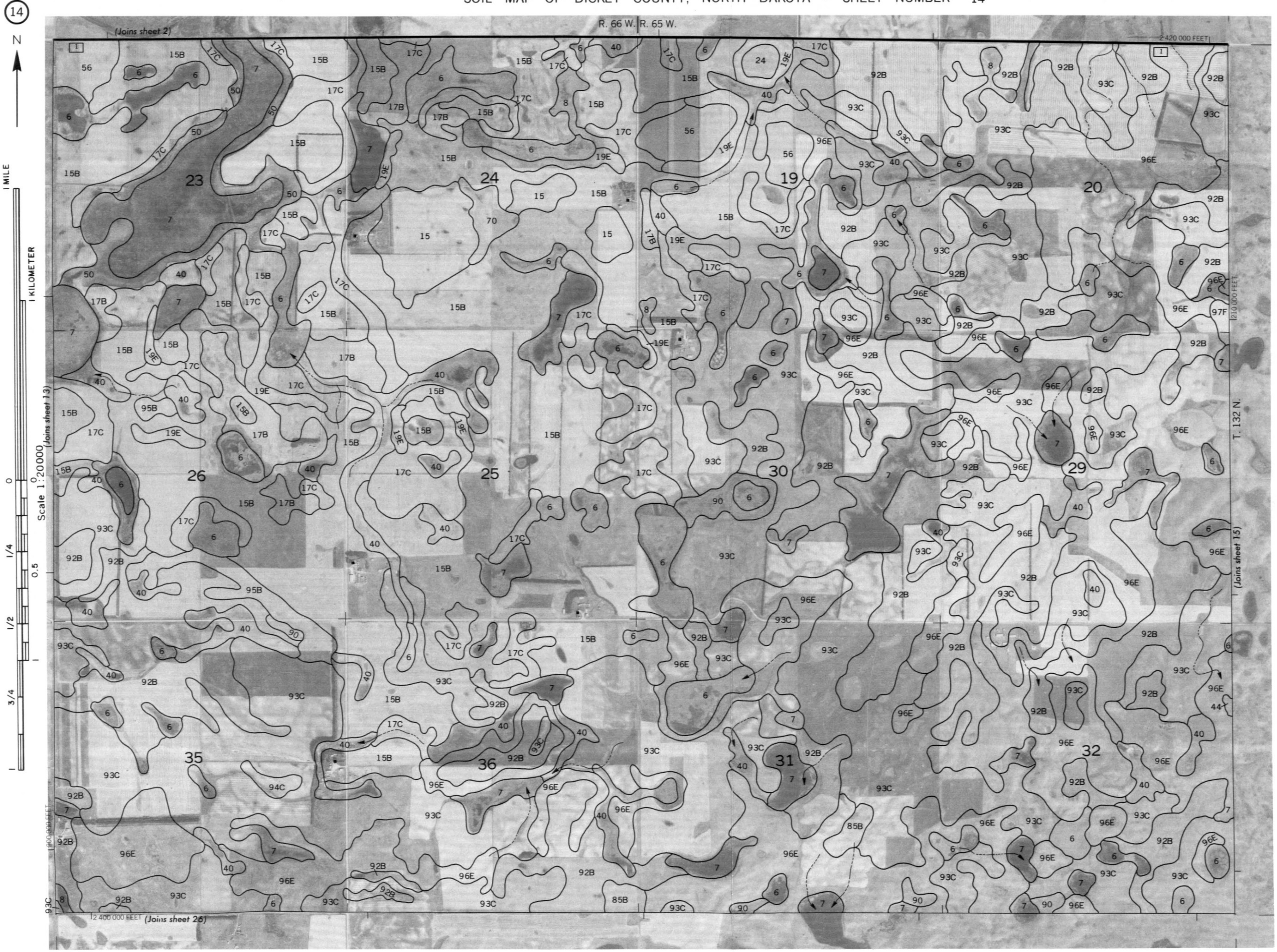
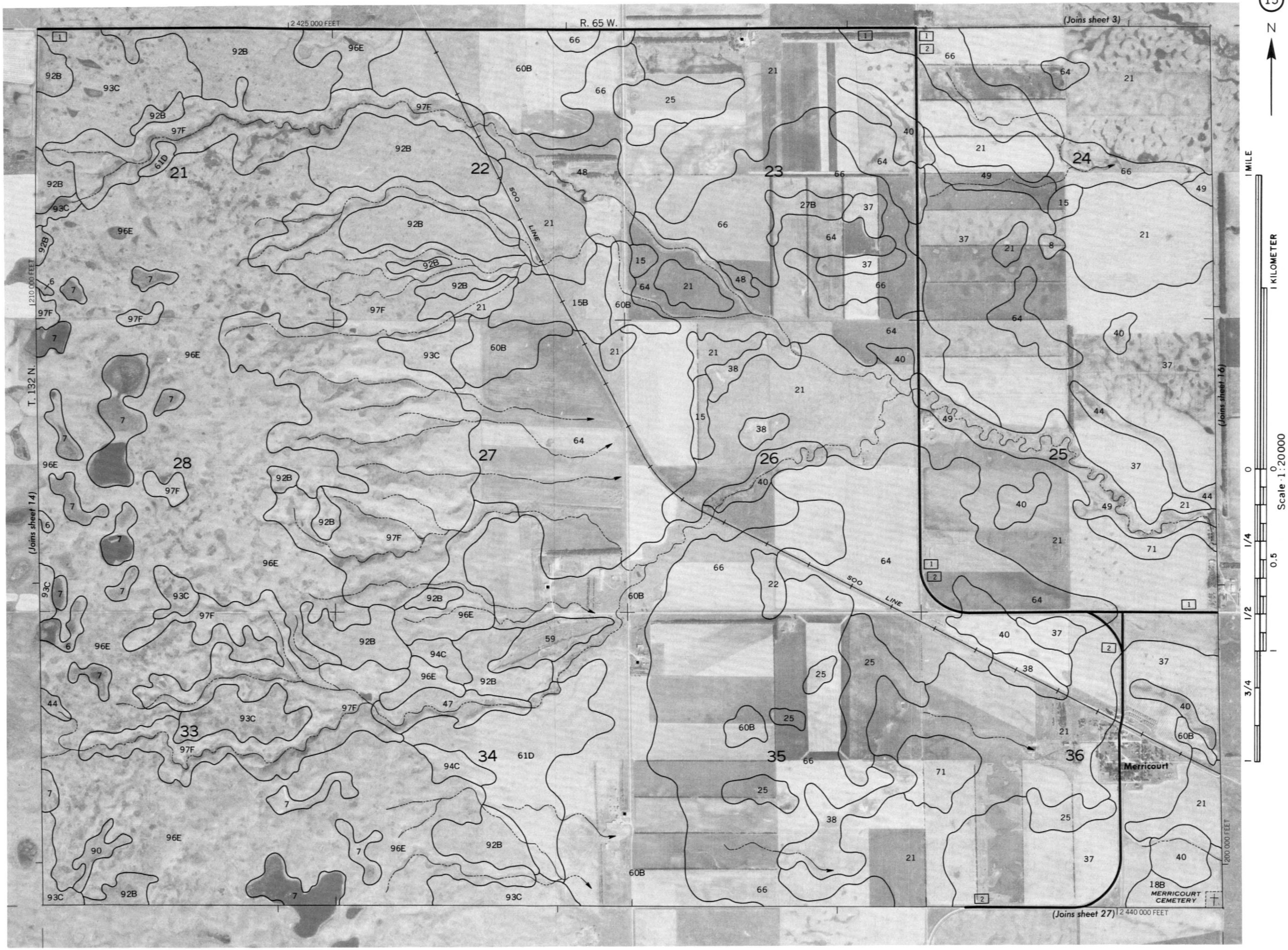
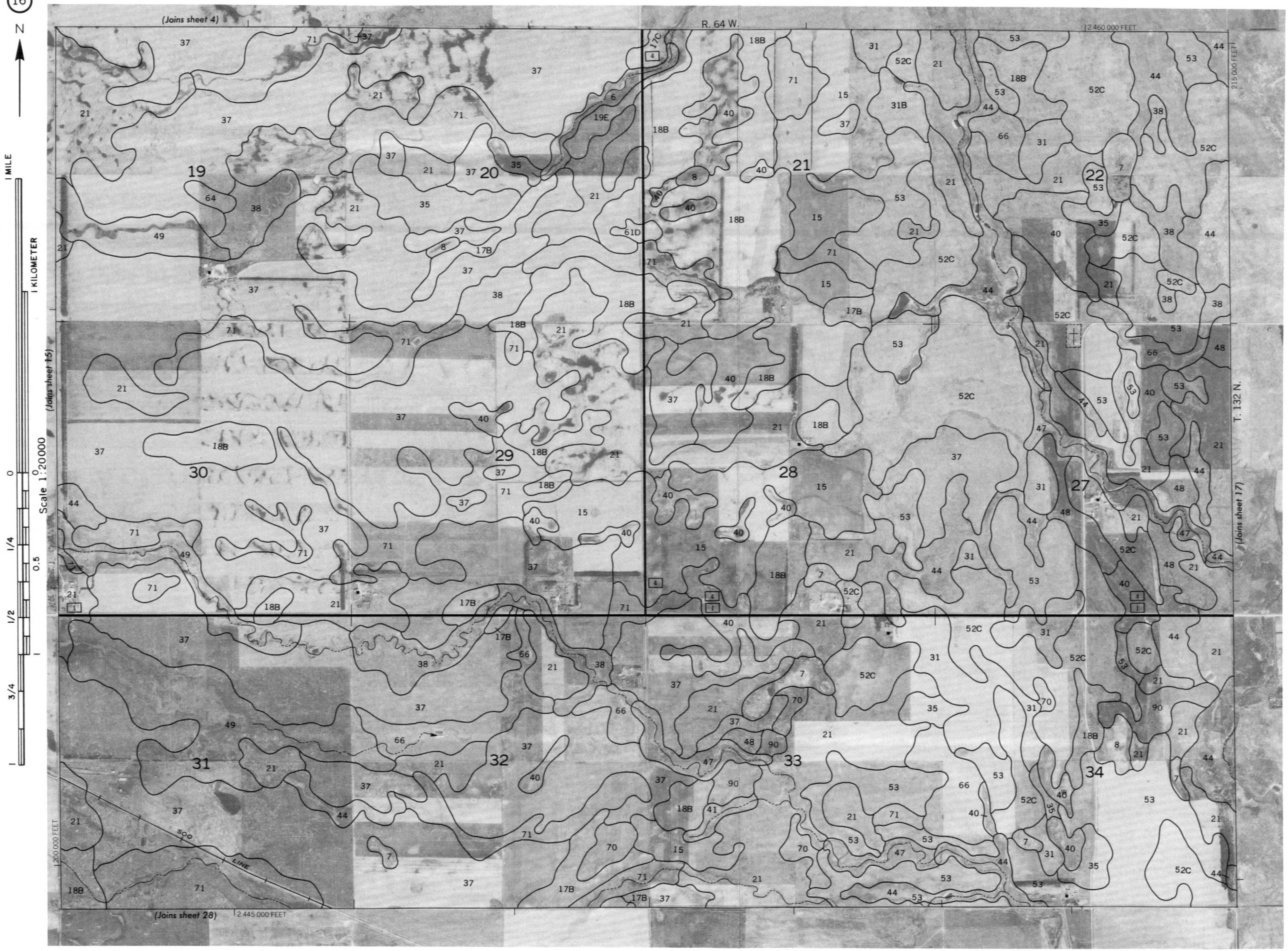


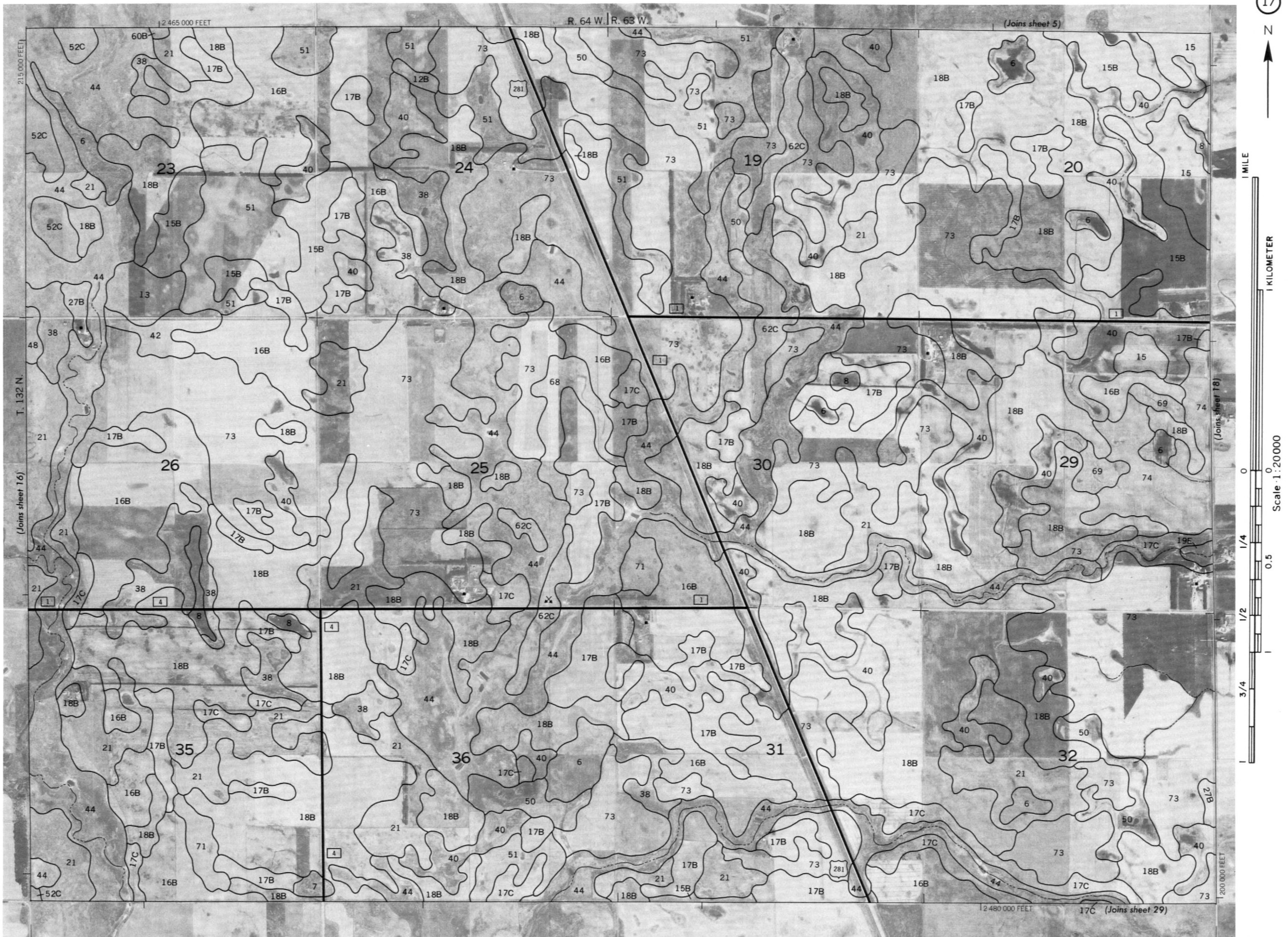

14
N
(Joins sheet 2)
R. 66 W. R. 65 W.
2 420 000 FEET
210 000 FEET
T. 132 N.
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 26)
2 400 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
23
24
19
20
26
25
30
29
35
36
31
32

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 15




N
(Joins sheet 4)
R. 64 W.
2 460 000 FEET
215 000 FEET
T. 132 N.
(Joins sheet 17)
(Joins sheet 15)
(Joins sheet 28)
2 445 000 FEET
200 000 FEET
SOO LINE
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
19
20
21
22
27
28
29
30
31
32
33
34

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 17



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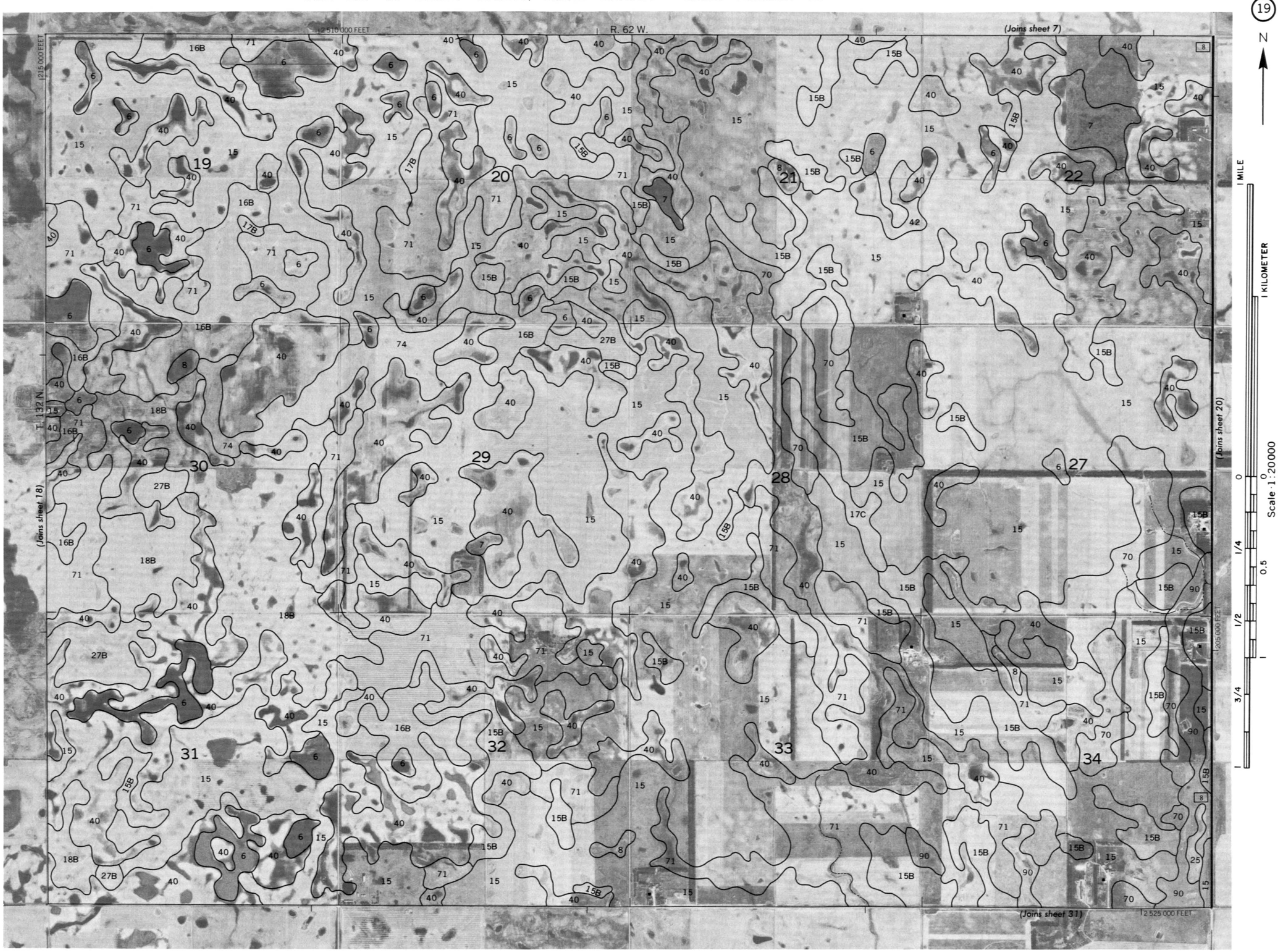
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 18

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 19



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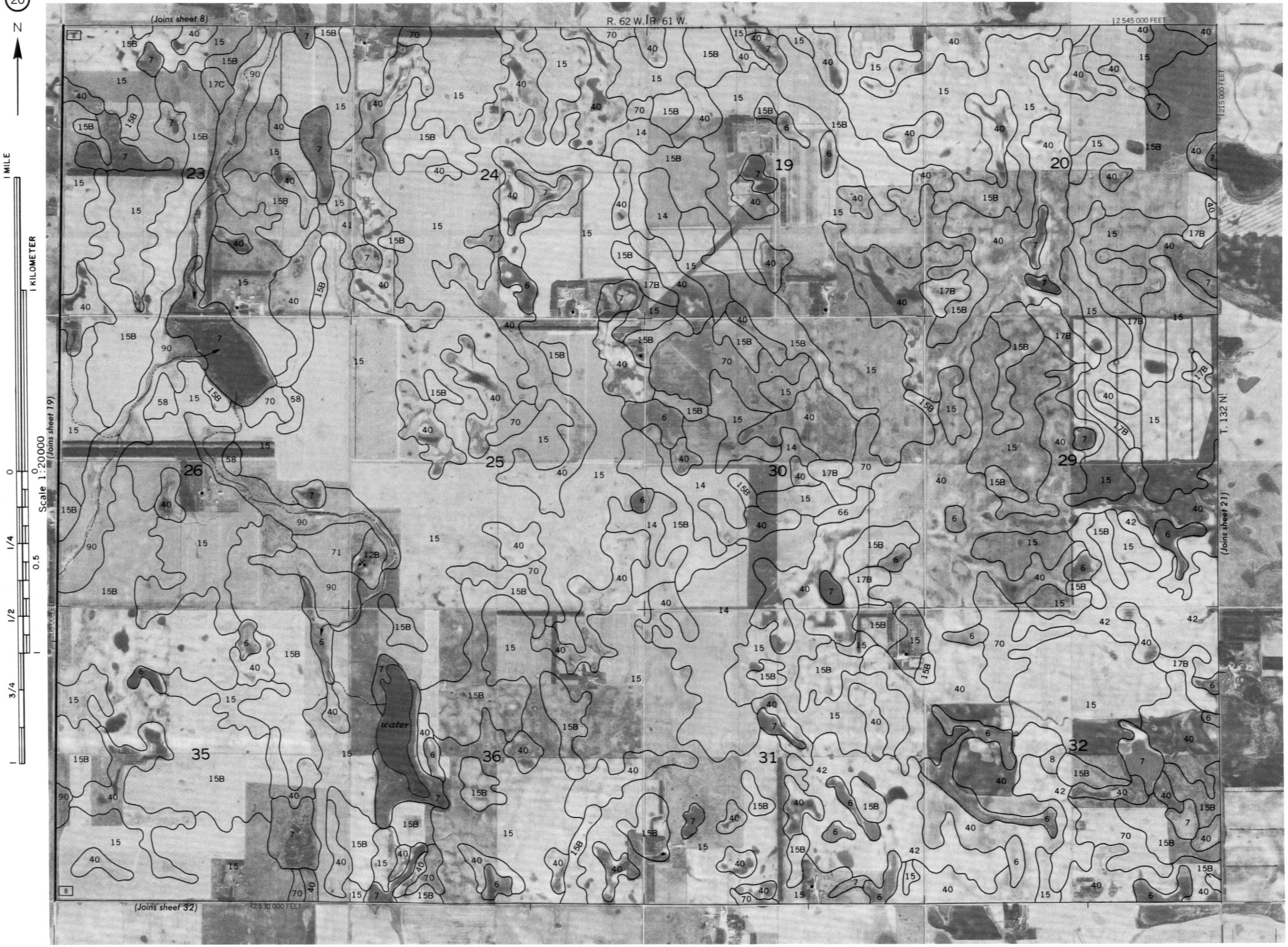

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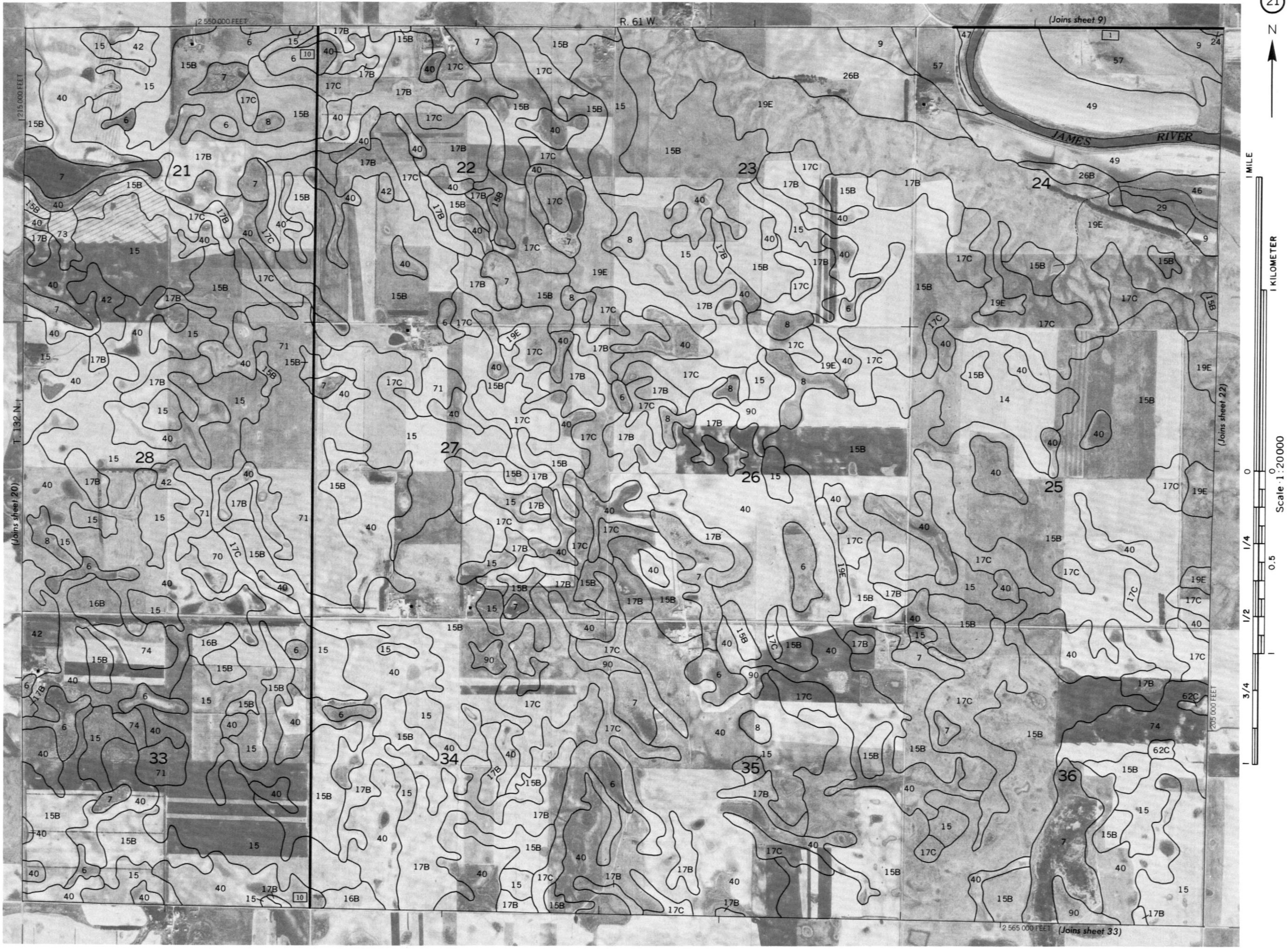

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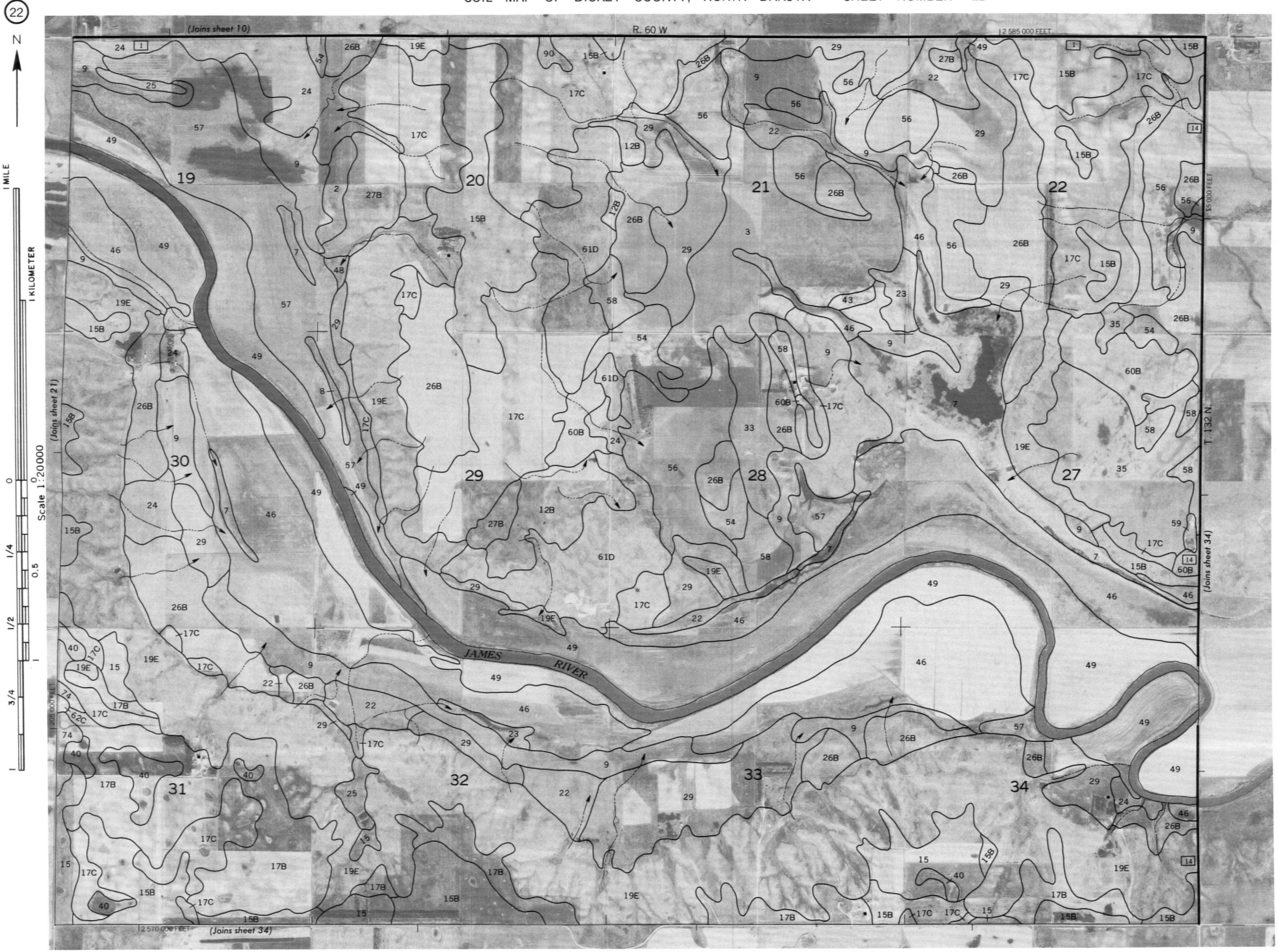

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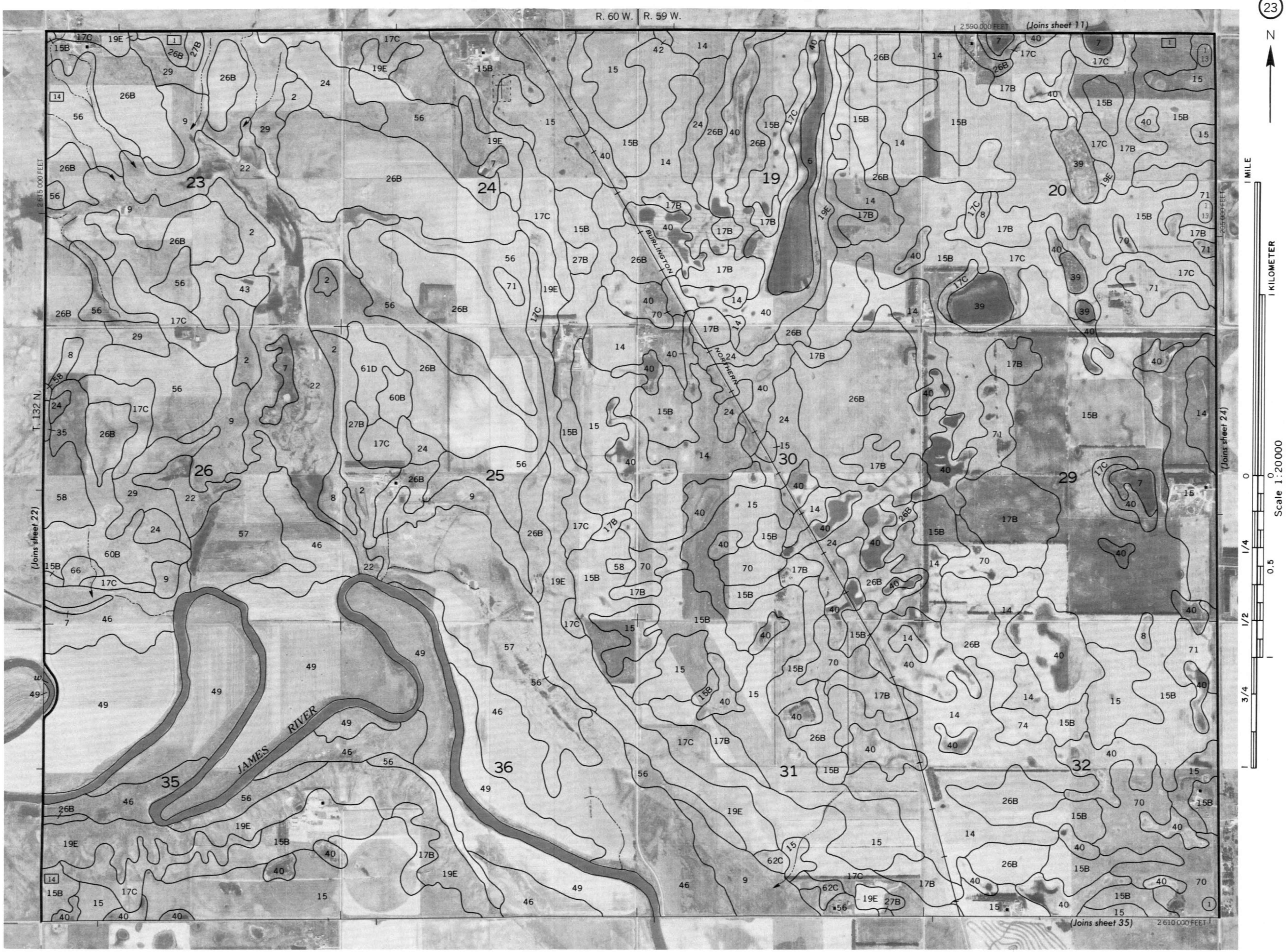

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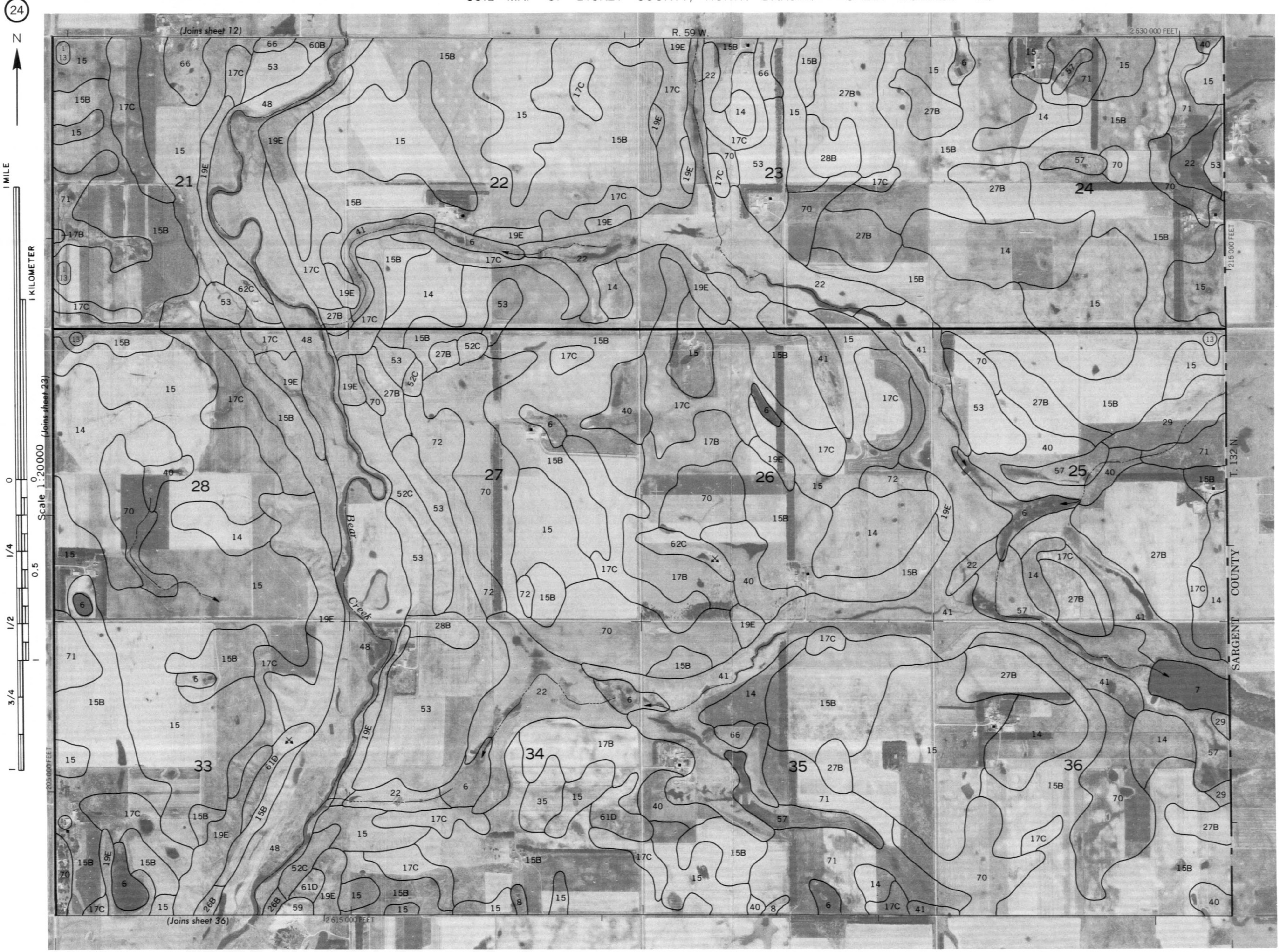

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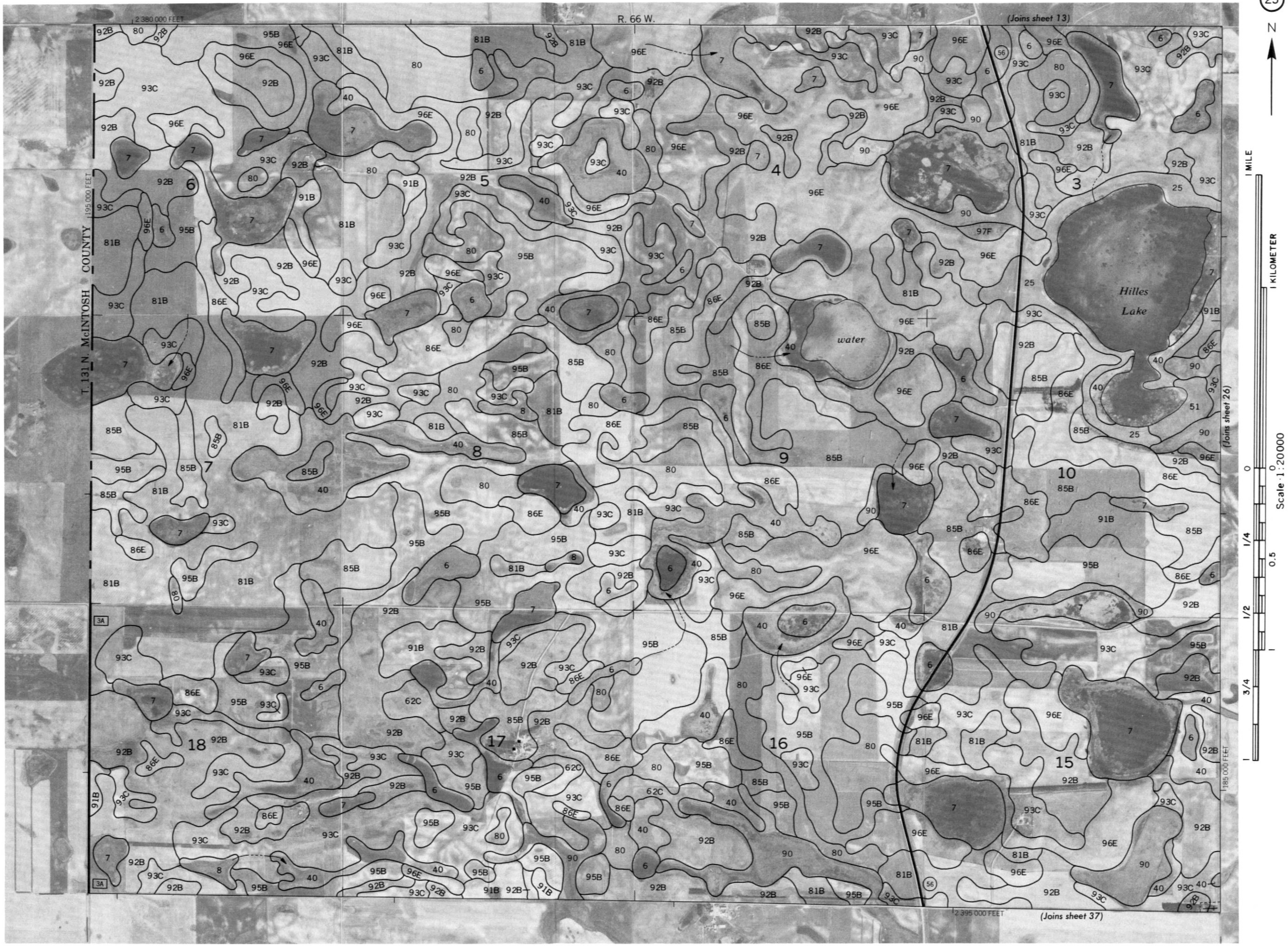
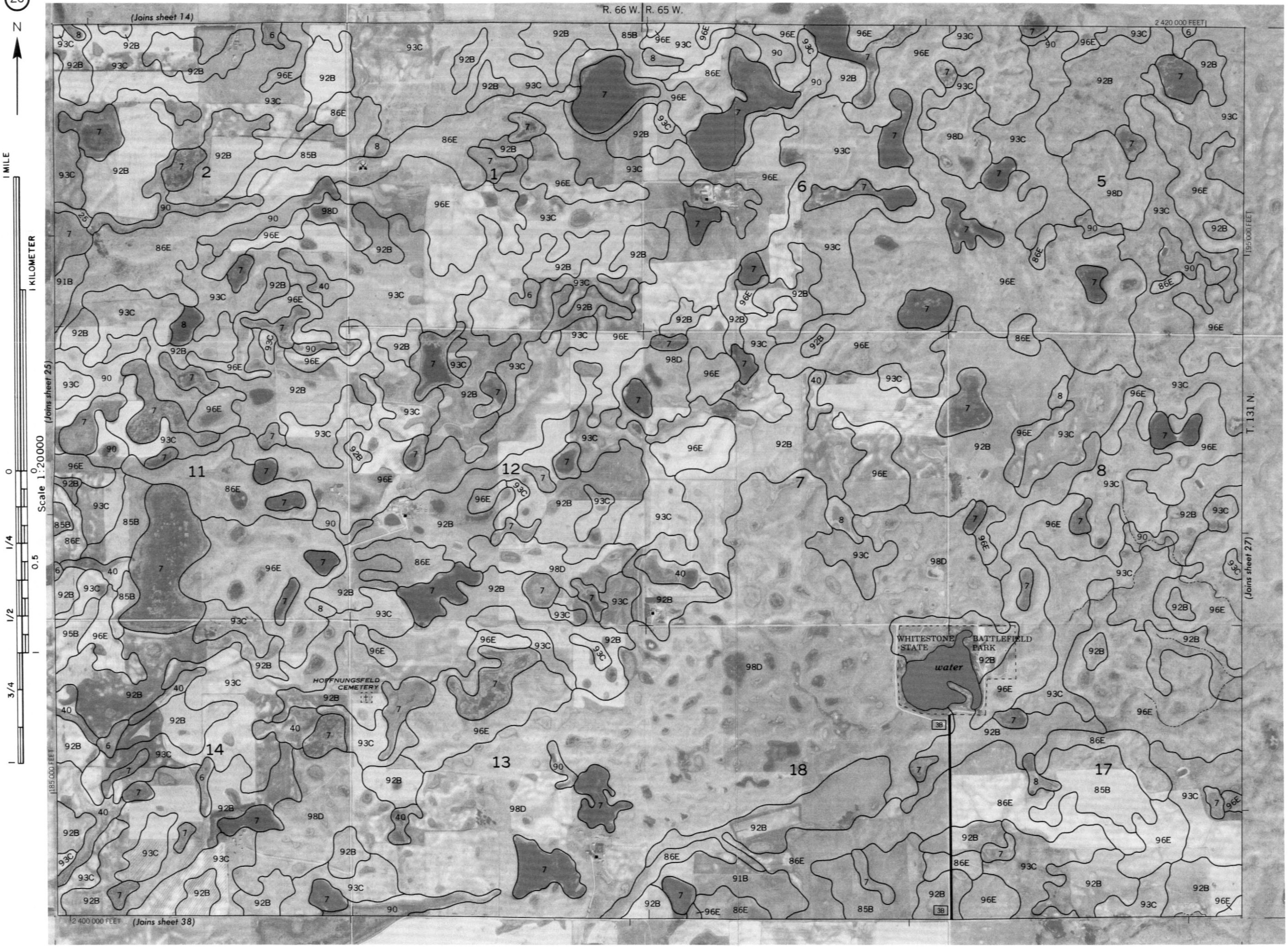
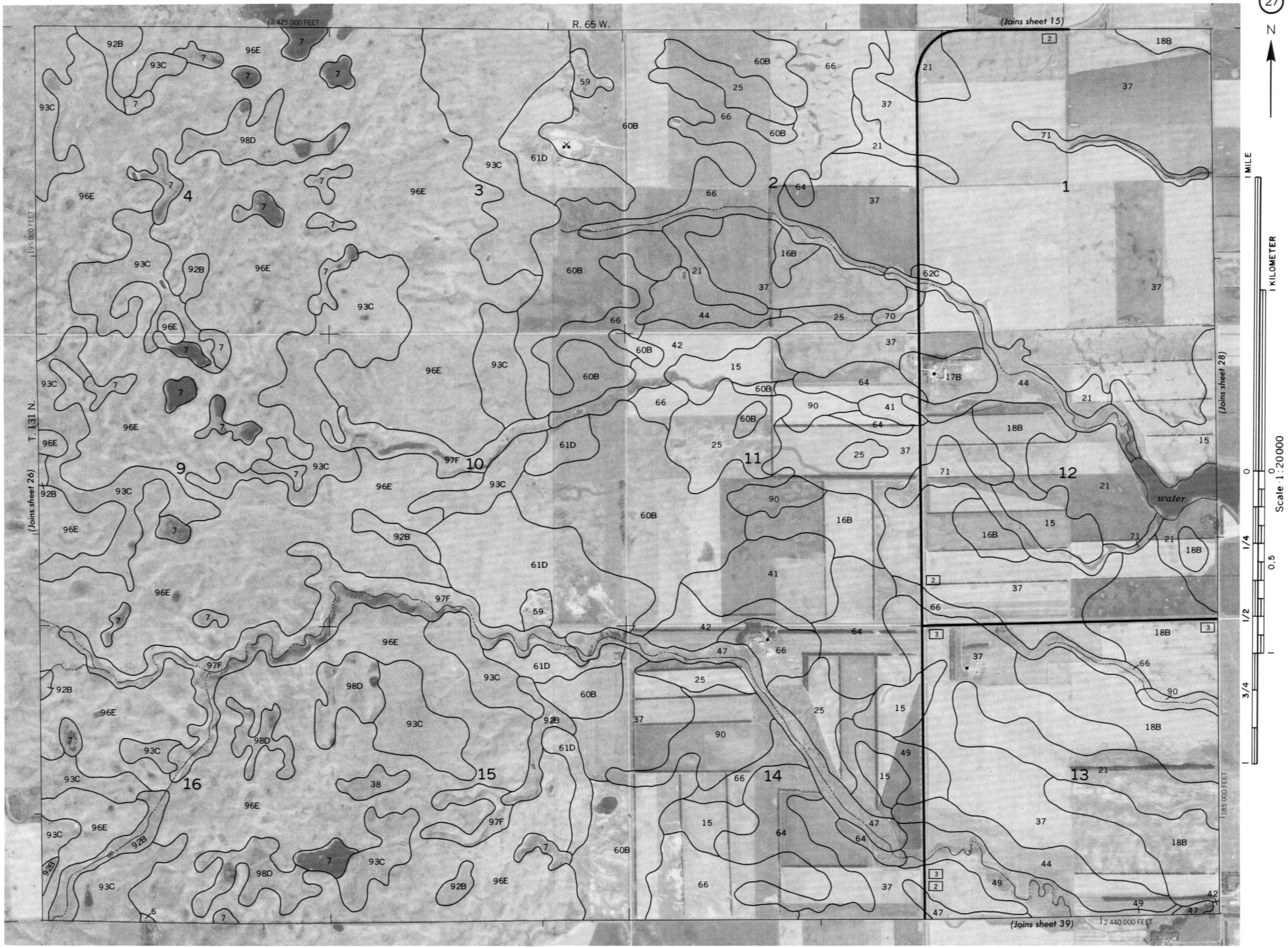
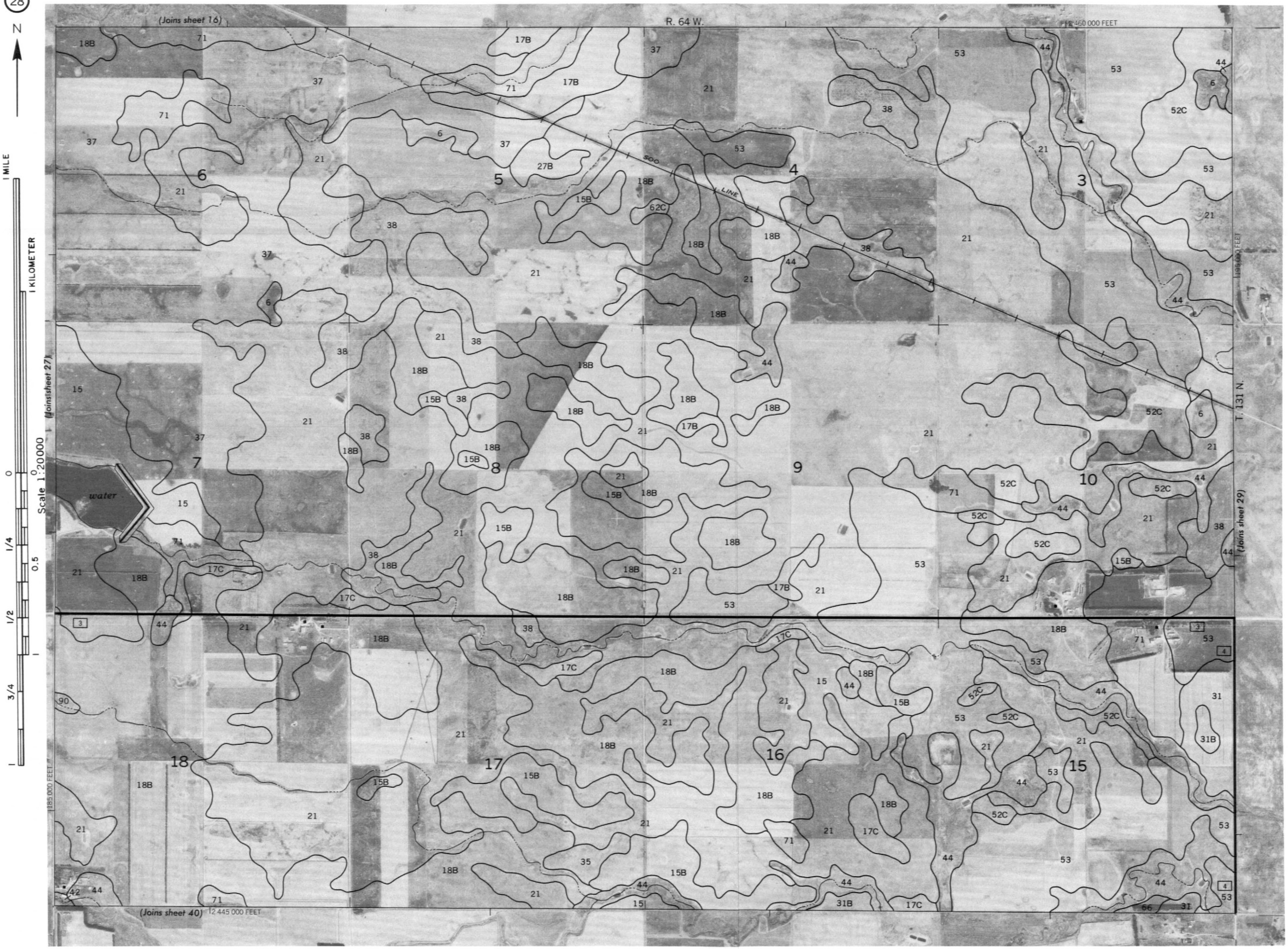
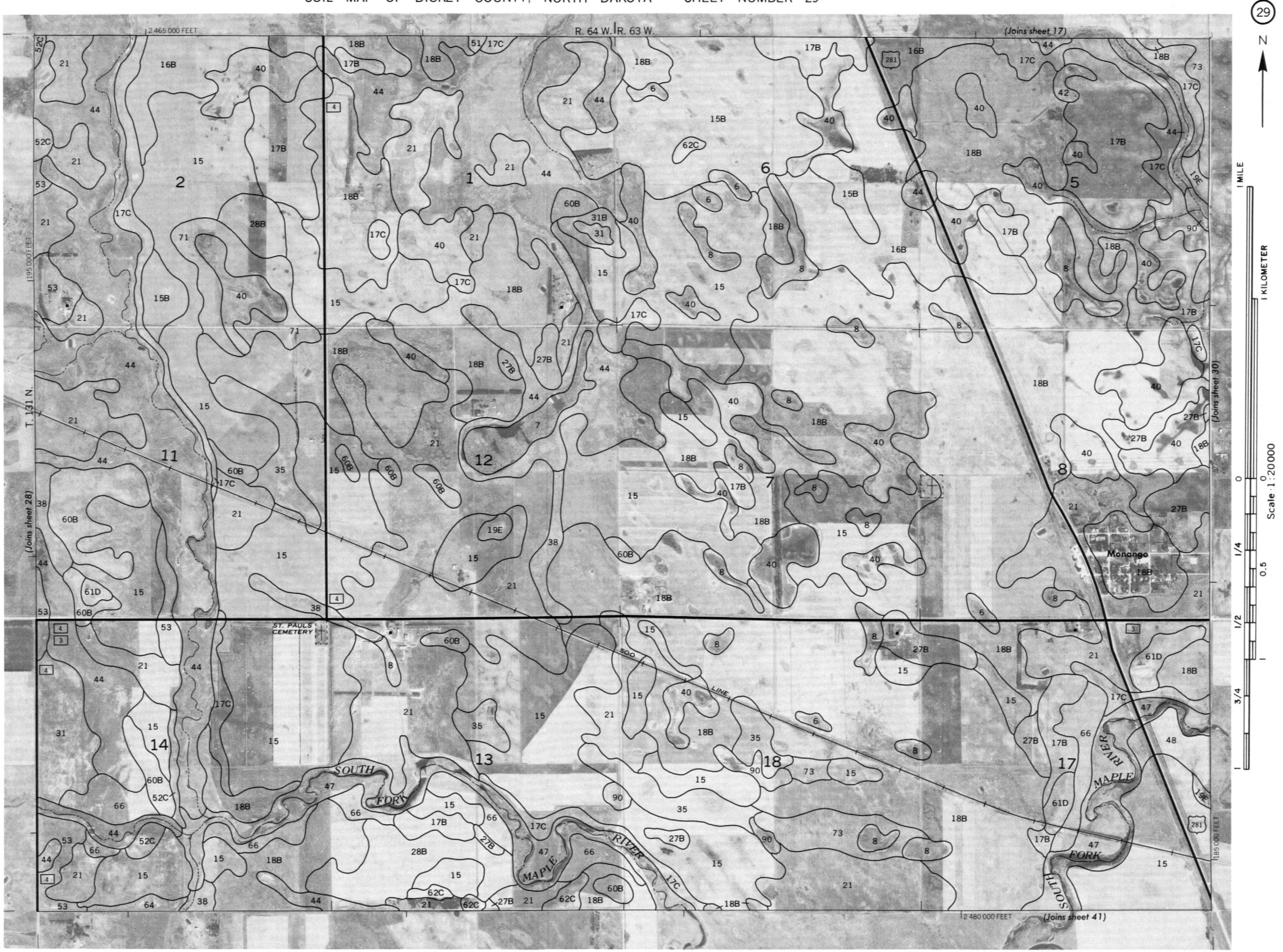


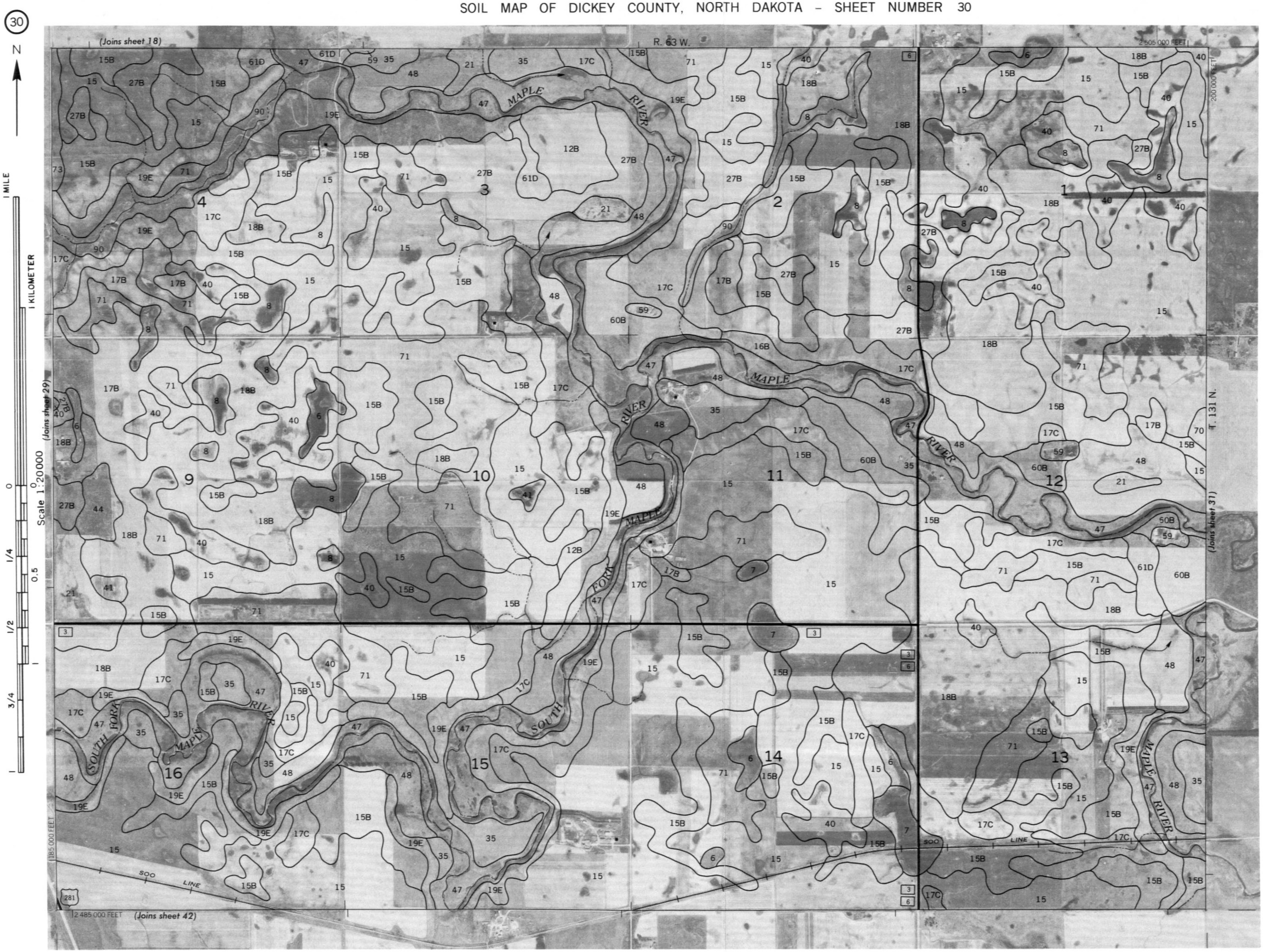

N
(Joins sheet 14)
R. 66 W. R. 65 W.
2 420 000 FEET
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 38)
2 400 000 FEET
195 000 FEET
185 000 FEET
T. 131 N.
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
WHITESTONE STATE
BATTLEFIELD PARK
water
HOFFNUNGSFELD CEMETERY
38
1
2
5
6
7
8
11
12
13
14
17
18


(Joins sheet 15)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 39)
R. 65 W.
T. 131 N.
2 425 000 FEET
2 440 000 FEET
195 000 FEET
185 000 FEET
water
N
1 MILE
1 KILOMETER
Scale 1:20000


N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 16)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 40)
R. 64 W.
T. 131 N.
2 460 000 FEET
2 445 000 FEET
SOO LINE
water

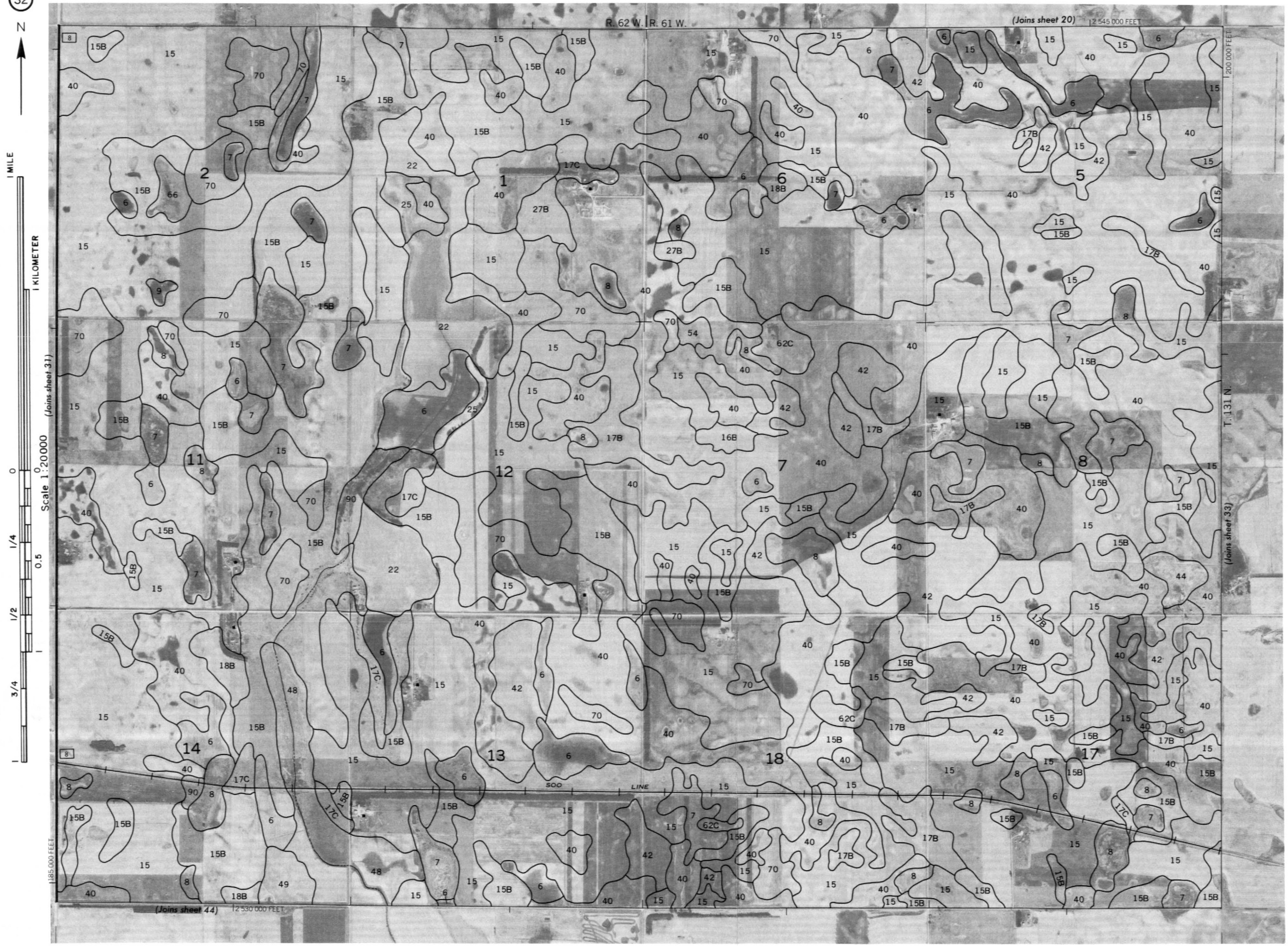

2 465 000 FEET
R. 64 W. R. 63 W.
(Joins sheet 17)
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0
0.5
195 000 FEET
T. 131 N.
(Joins sheet 28)
(Joins sheet 30)
ST. PAULS CEMETERY
Monango
SOO LINE
SOUTH FORK
MAPLE RIVER
MAPLE
RIVER
FORK
SOUTH
281
185 000 FEET
2 480 000 FEET
(Joins sheet 41)

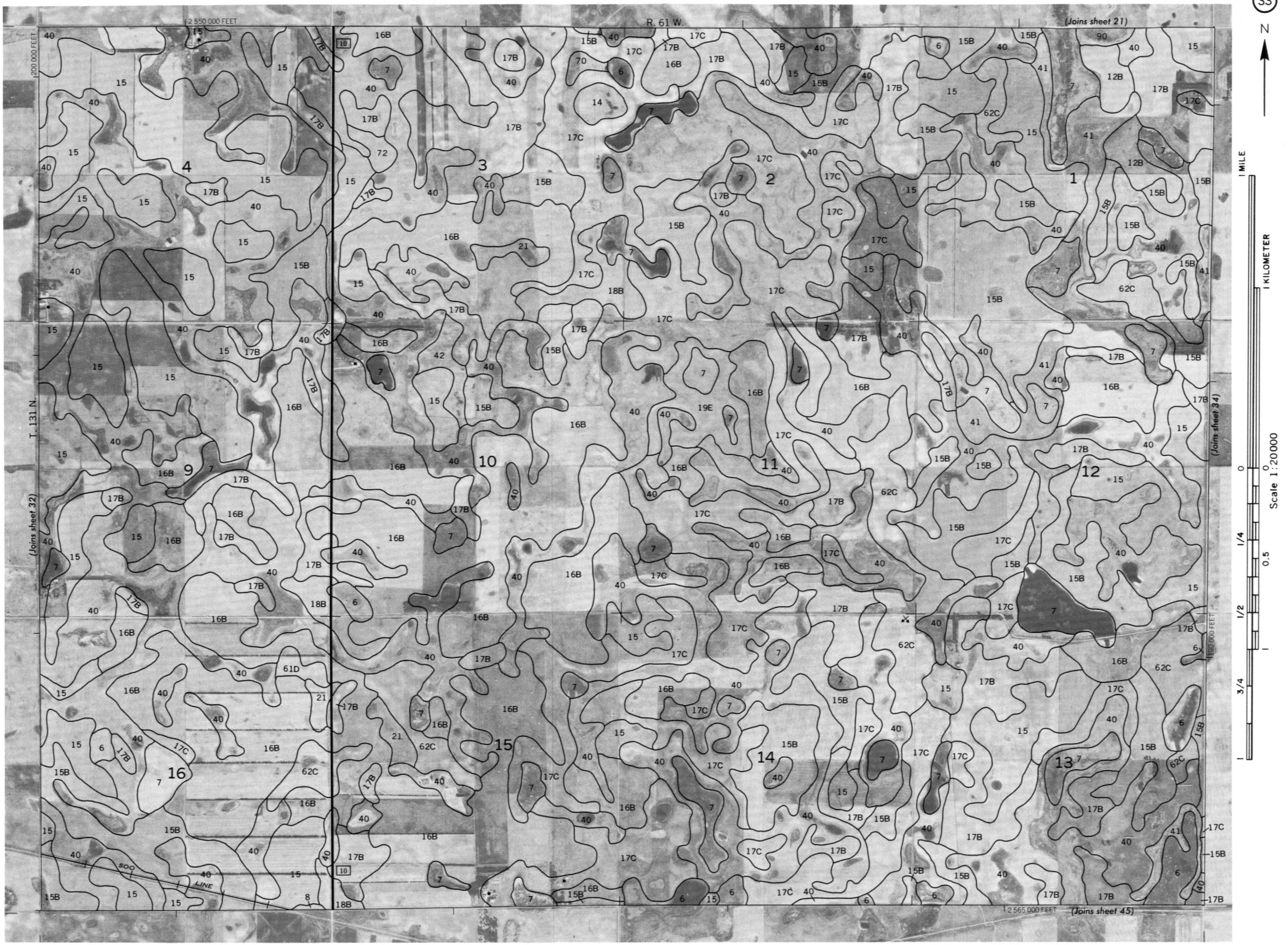
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 30



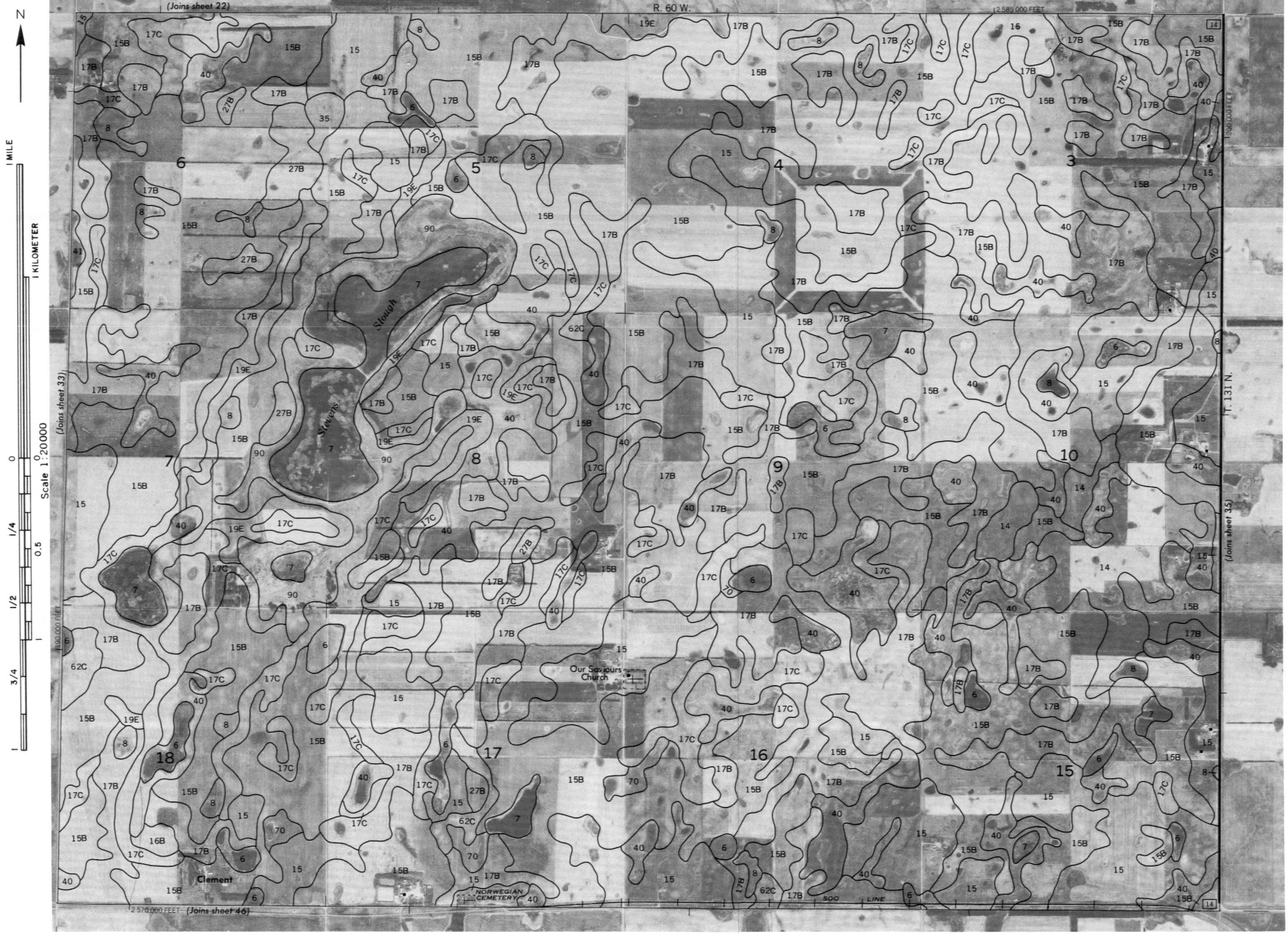

2 510 000 FEET
R. 62 W.
(Joins sheet 19)
200 000 FEET
T. 131 N.
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 43)
2 525 000 FEET
185 000 FEET
MAPLE
RIVER
SOO
LINE
MAPLE VIEW CEMETERY
Fullerton
N
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
Scale 1:20000

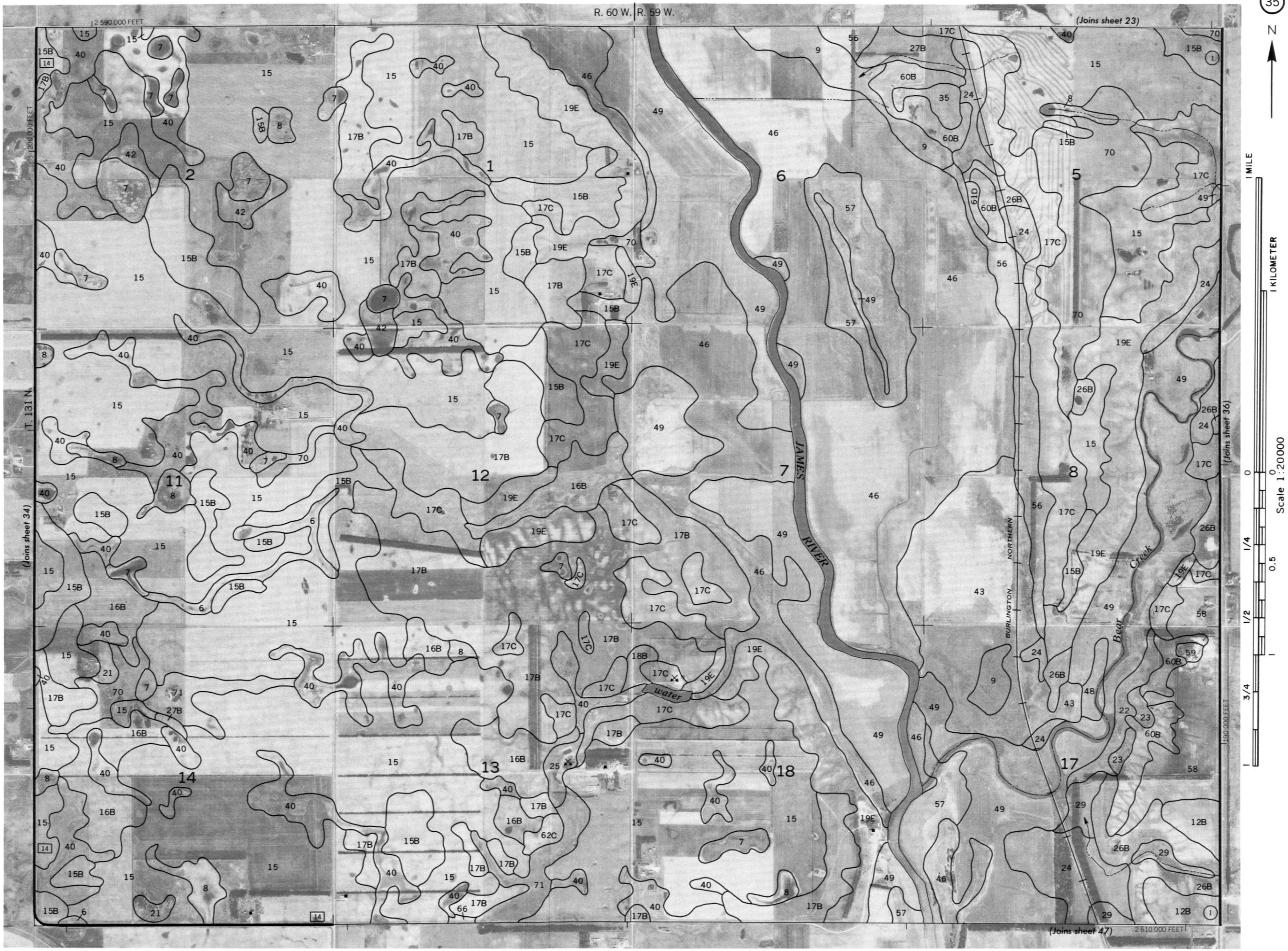
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 32



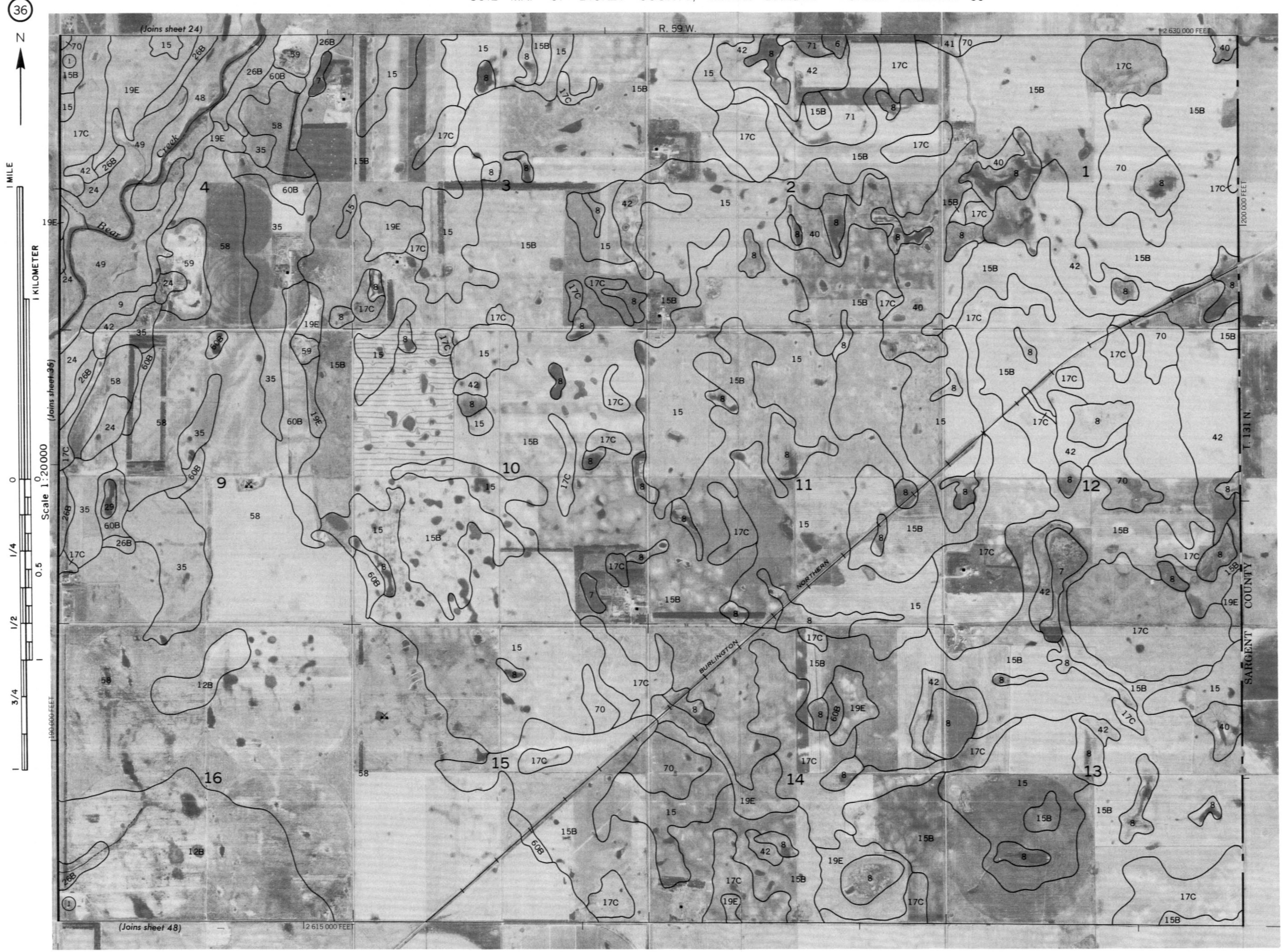

33
N
R. 61 W.
(Joins sheet 21)
(Joins sheet 32)
(Joins sheet 34)
(Joins sheet 45)
T. 131 N.
2 550 000 FEET
200 000 FEET
2 565 000 FEET
150 000 FEET
SOO LINE
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 34

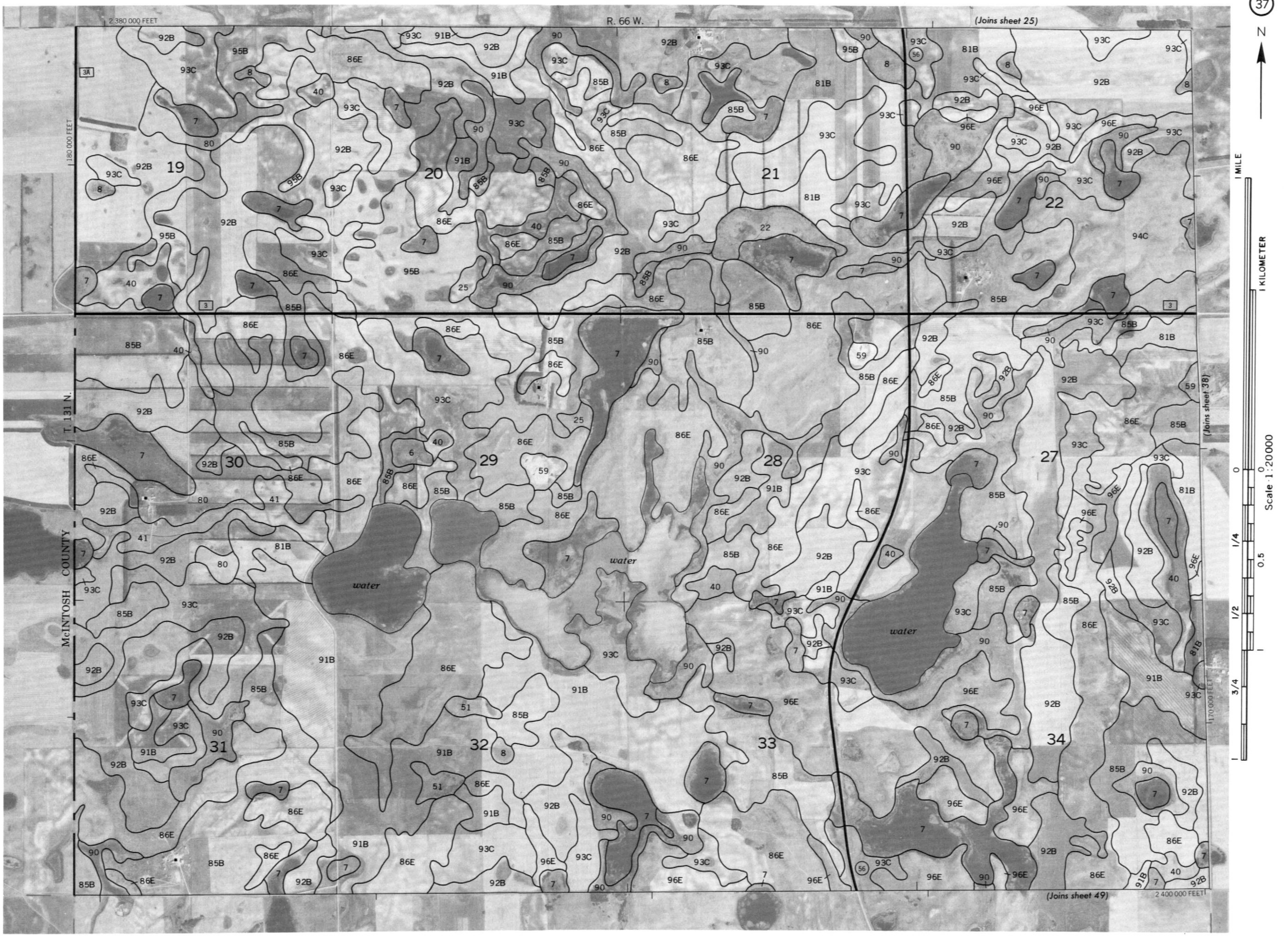




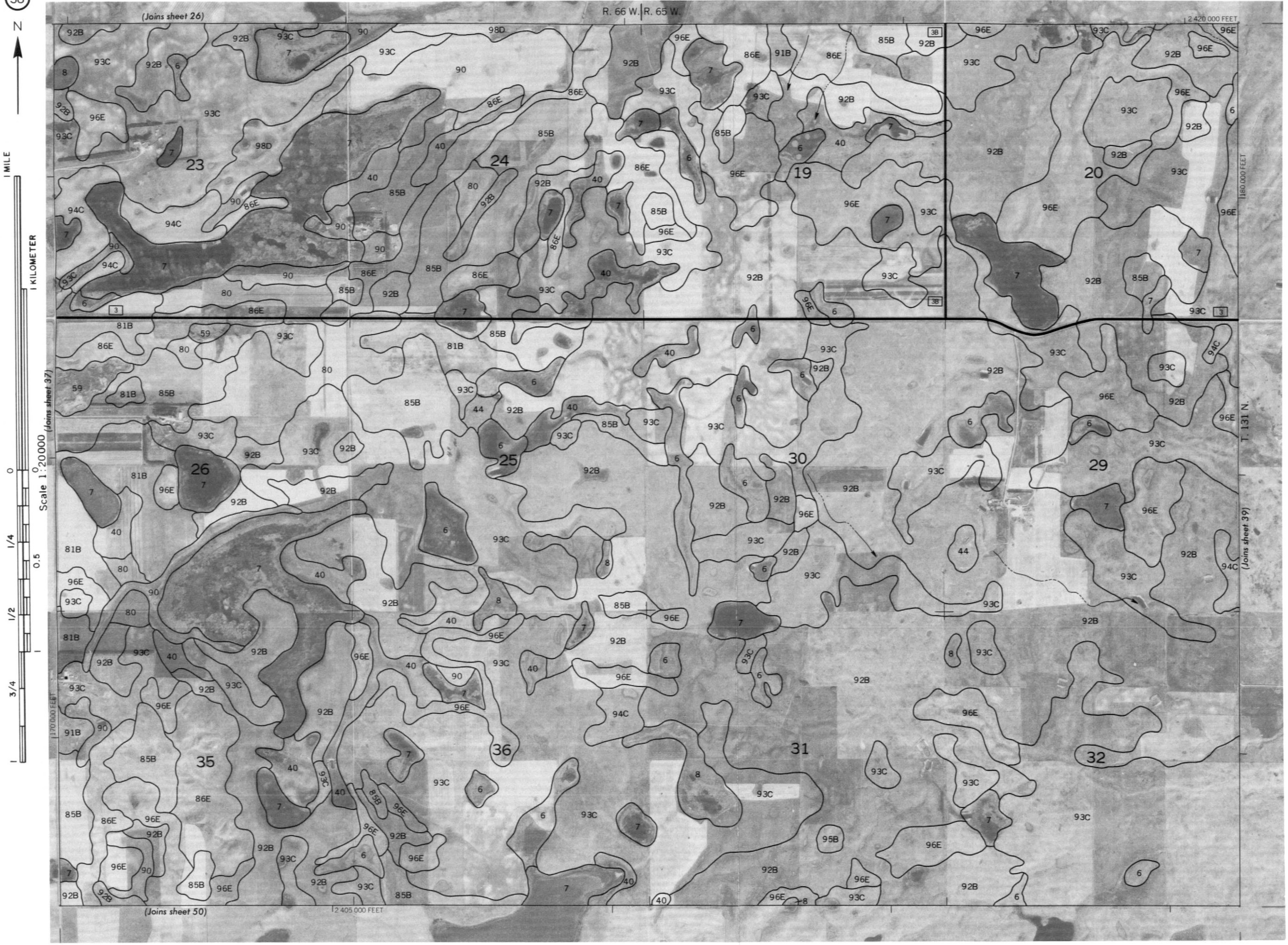
35
N
R. 60 W. | R. 59 W.
(Joins sheet 23)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 47)
T. 131 N.
2 590 000 FEET
2 610 000 FEET
JAMES RIVER
Bear Creek
BURLINGTON NORTHERN
water
1 MILE
1 KILOMETER
Scale 1:20000


36
N
(Joins sheet 24)
R. 59 W.
2 630 000 FEET
200 000 FEET
T. 131 N.
SARGENT COUNTY
(Joins sheet 35)
(Joins sheet 48)
2 615 000 FEET
190 000 FEET
Bear Creek
BURLINGTON NORTHERN
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

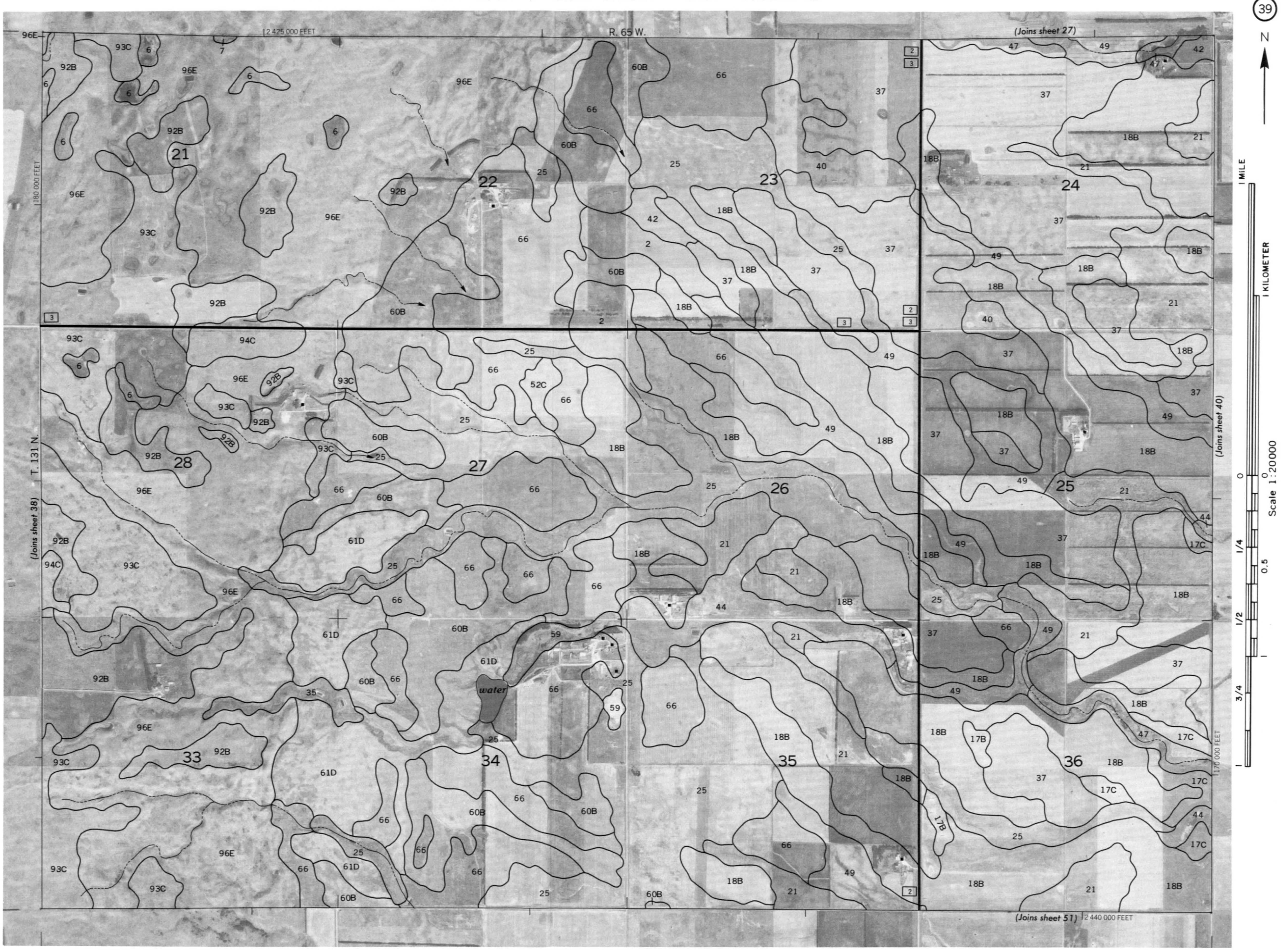
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 37



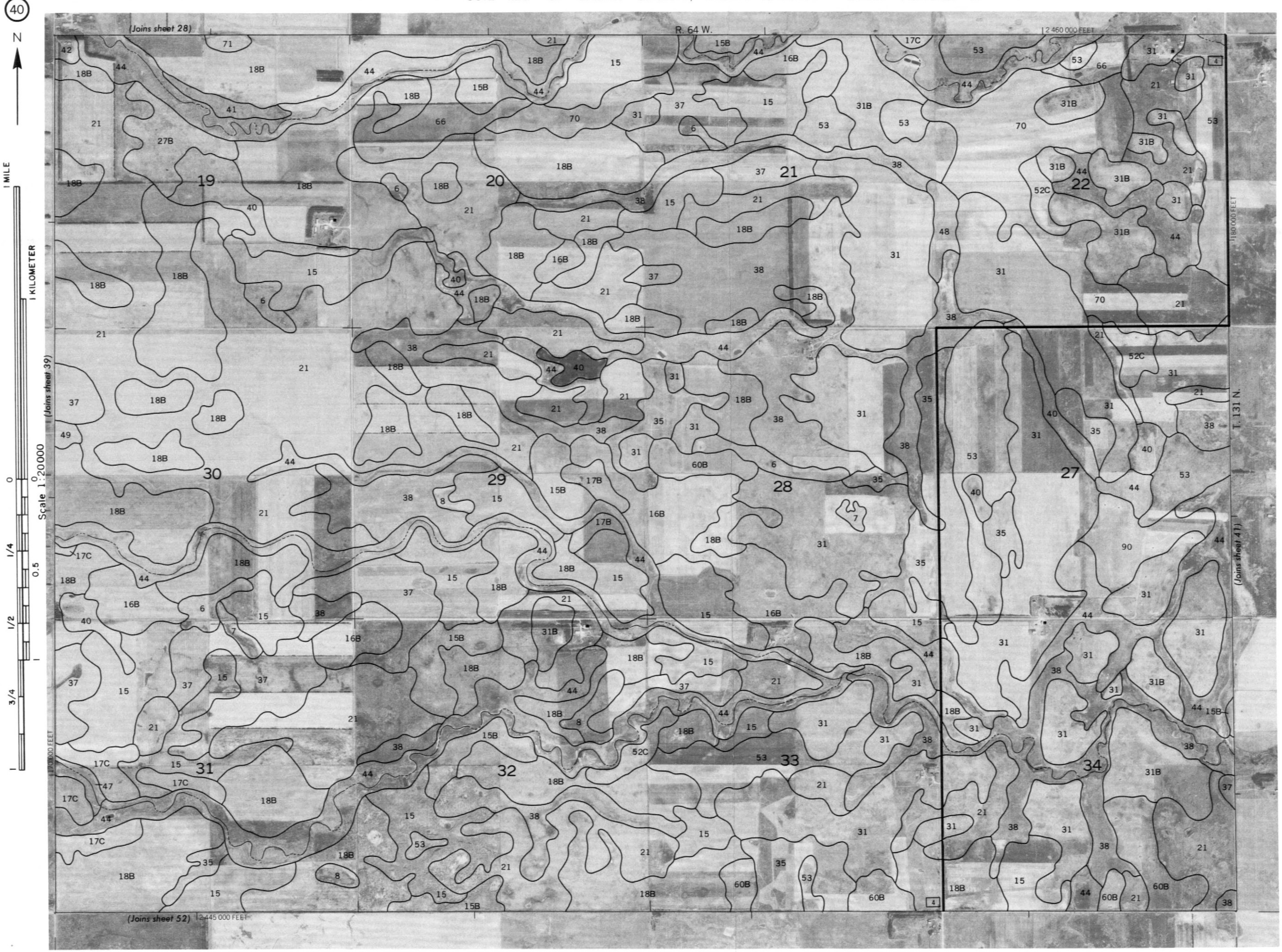
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 38

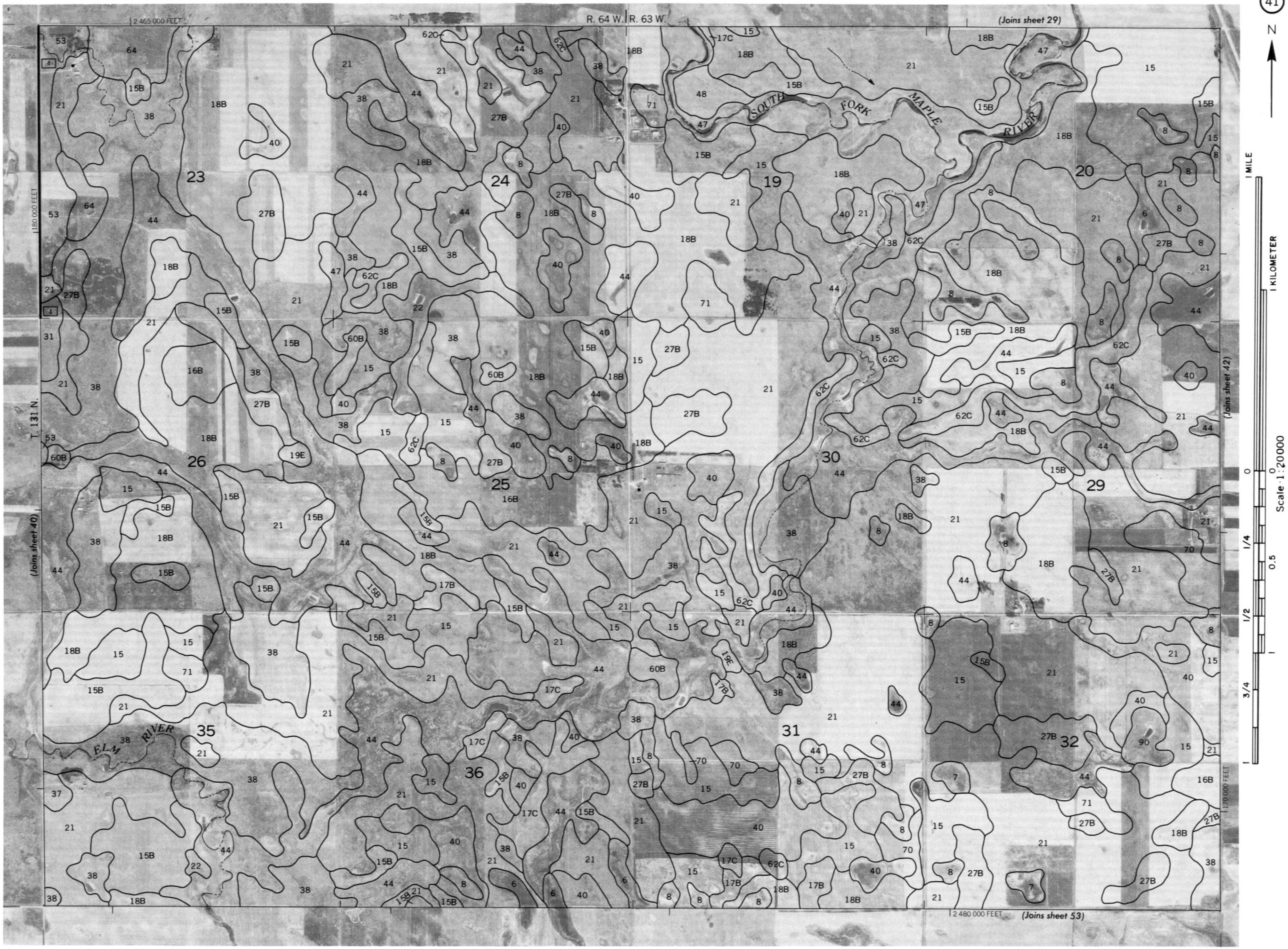


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 39

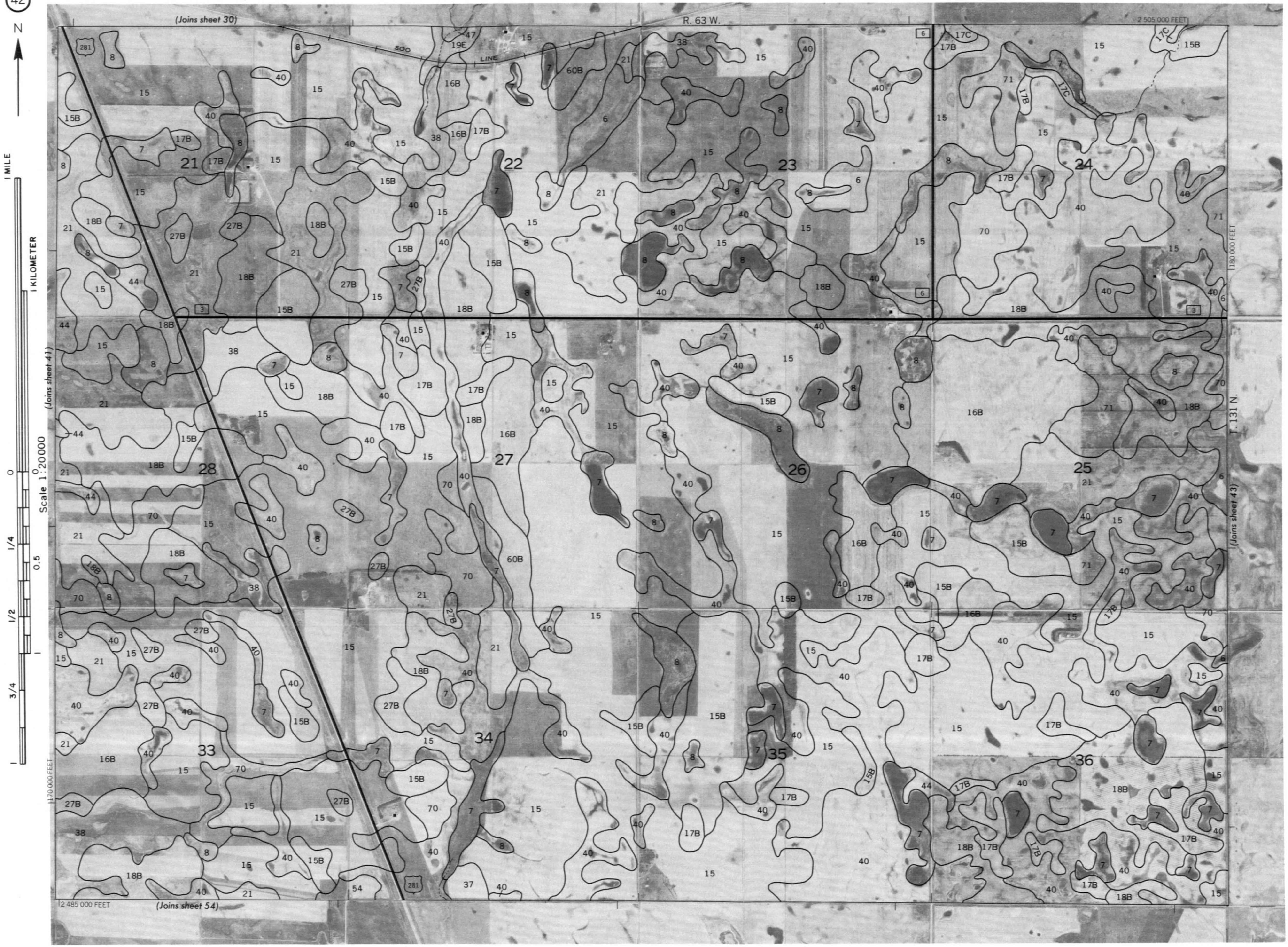


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 40



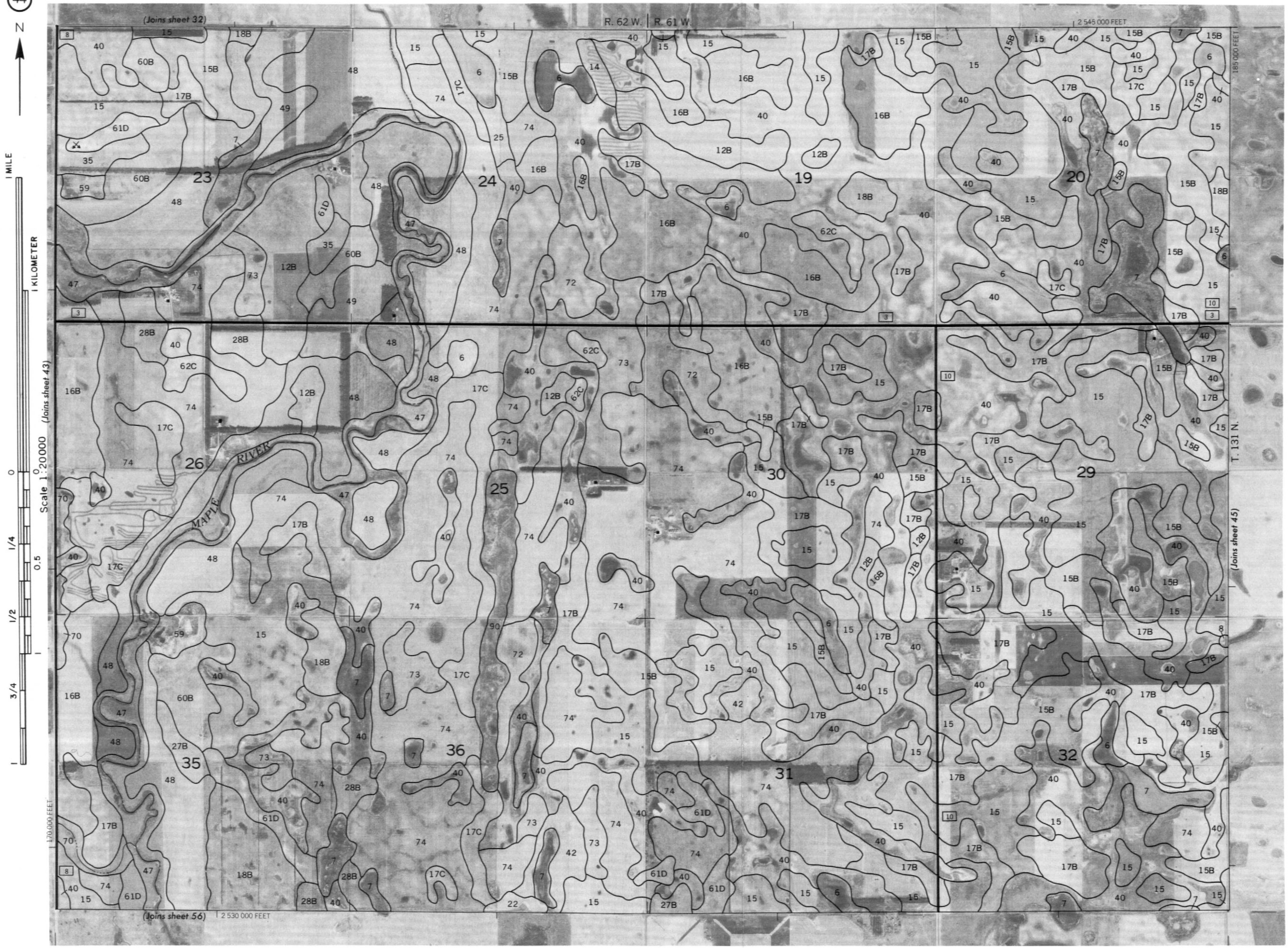

41
N
(Joins sheet 29)
(Joins sheet 42)
(Joins sheet 53)
(Joins sheet 40)
R. 64 W. | R. 63 W.
T. 131 N.
2 465 000 FEET
2 480 000 FEET
180 000 FEET
170 000 FEET
SOUTH FORK MAPLE RIVER
ELM RIVER
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 42

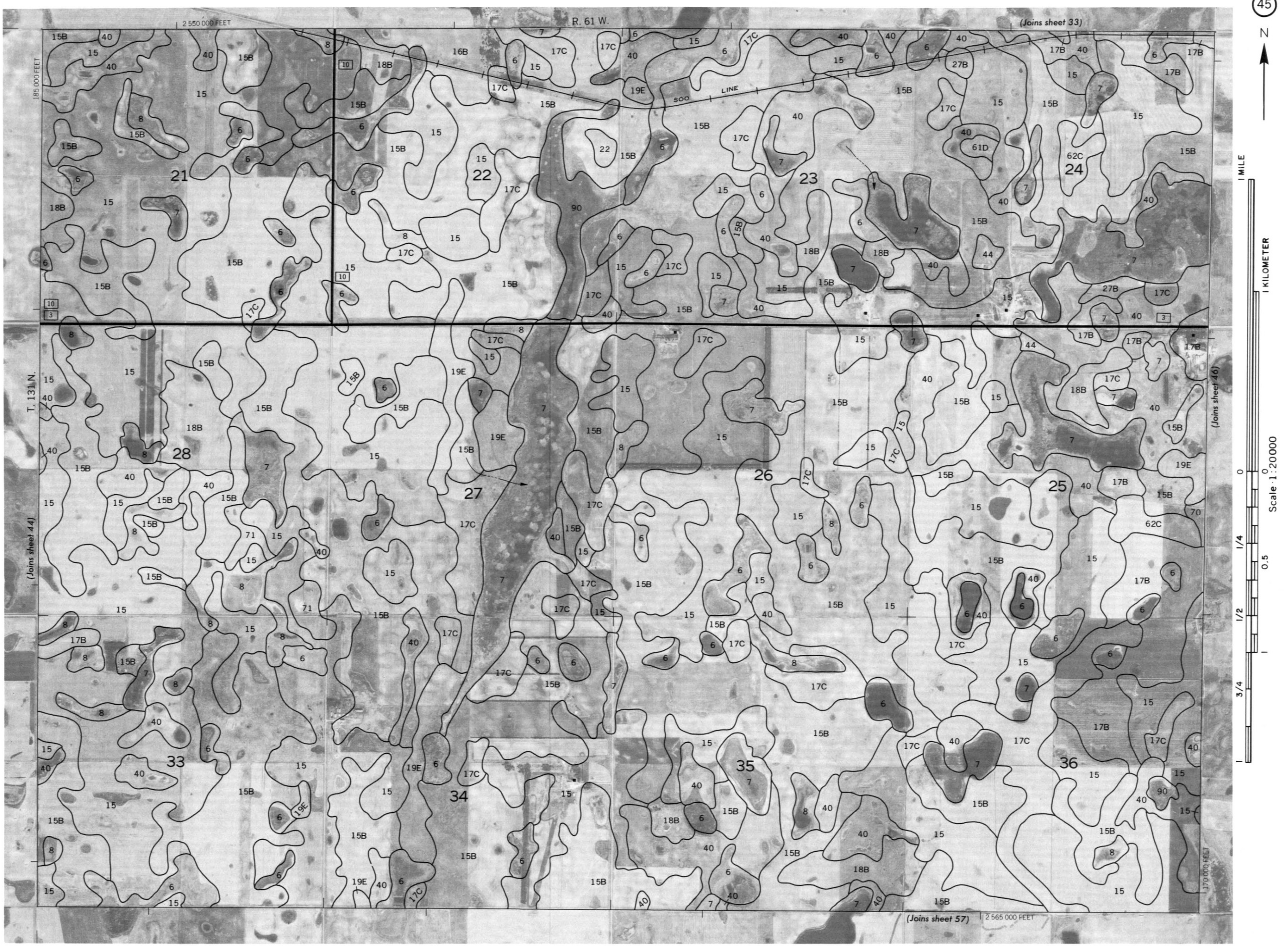


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 43

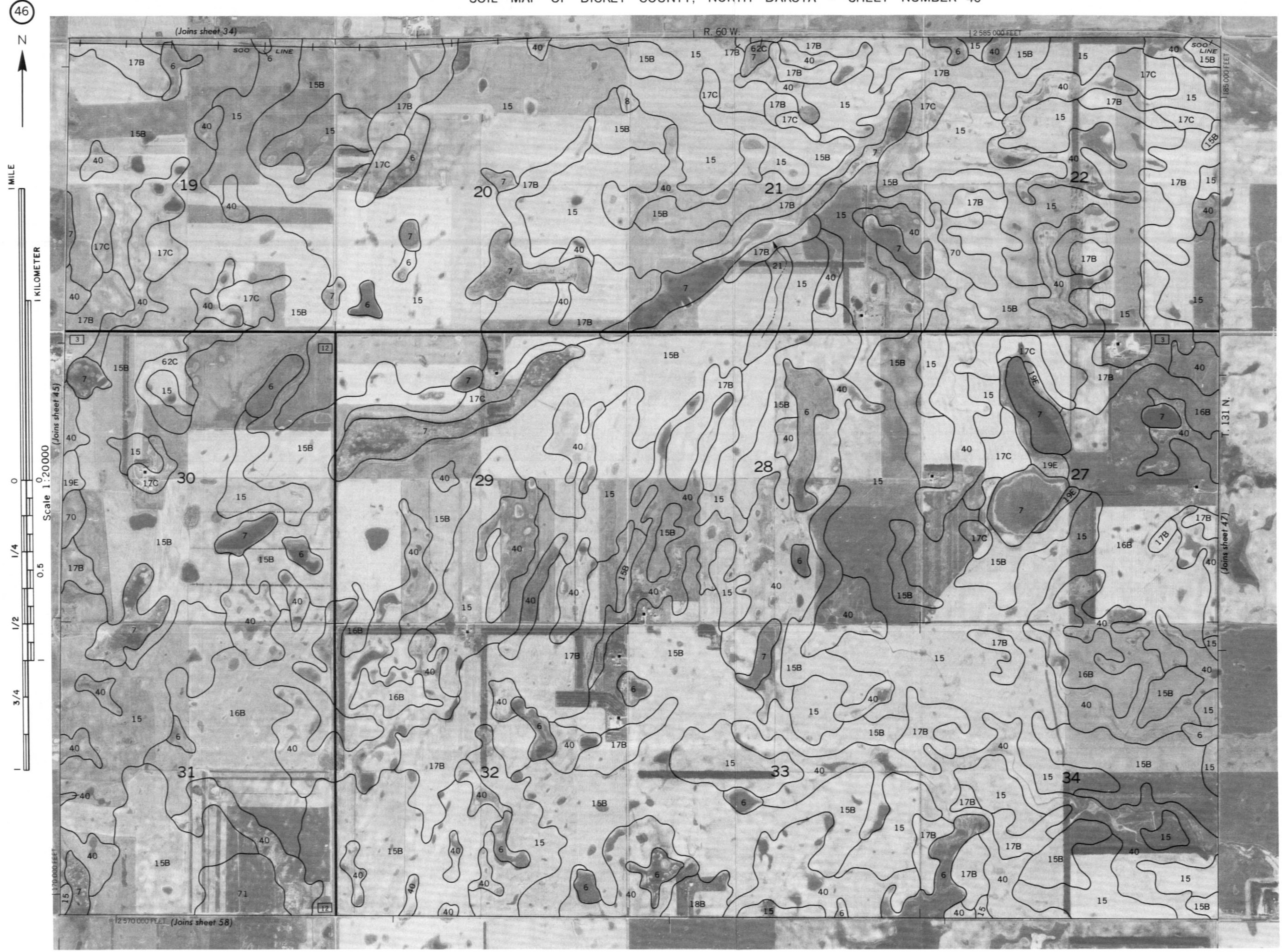
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 44



SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 45

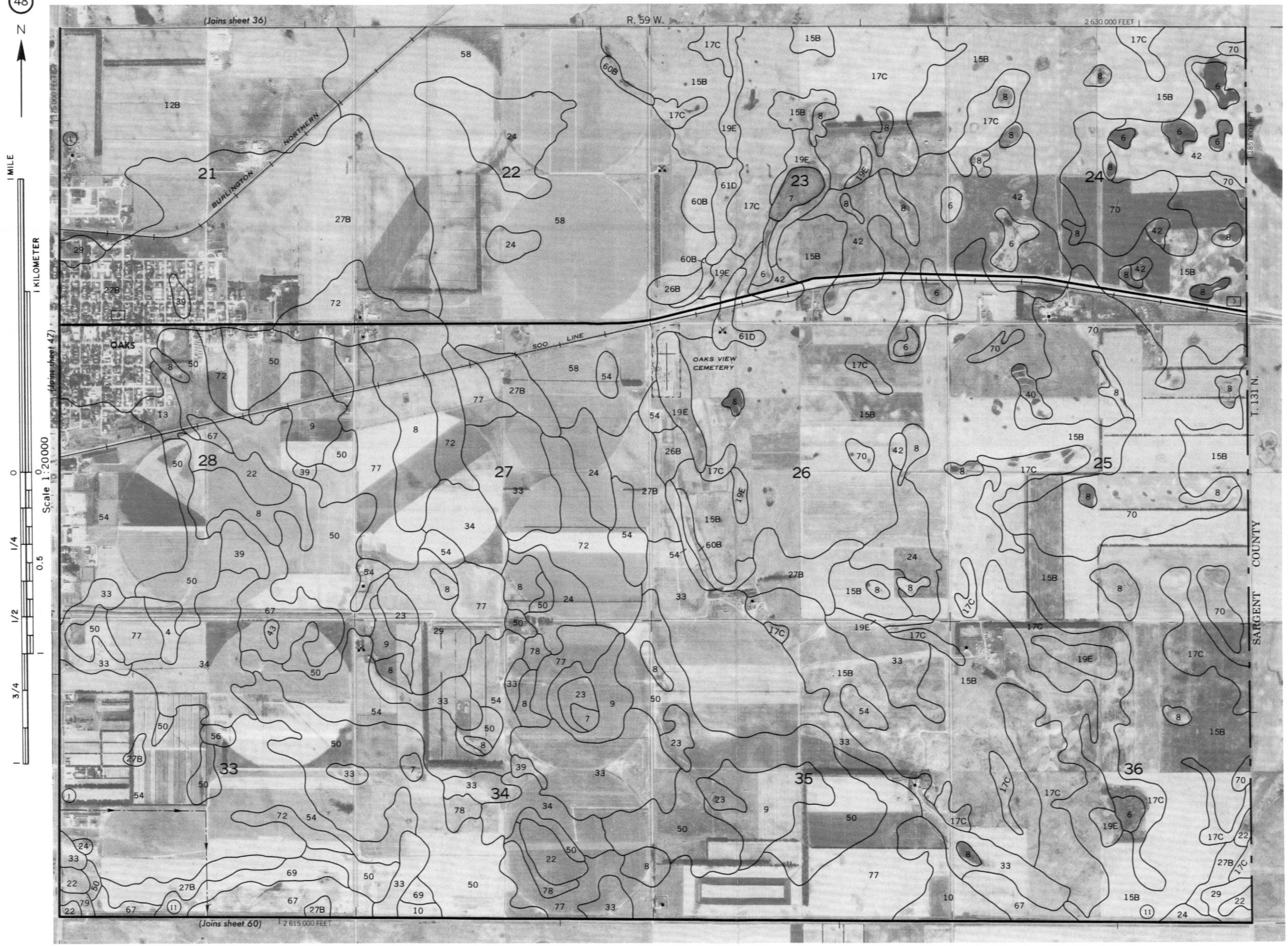


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 46



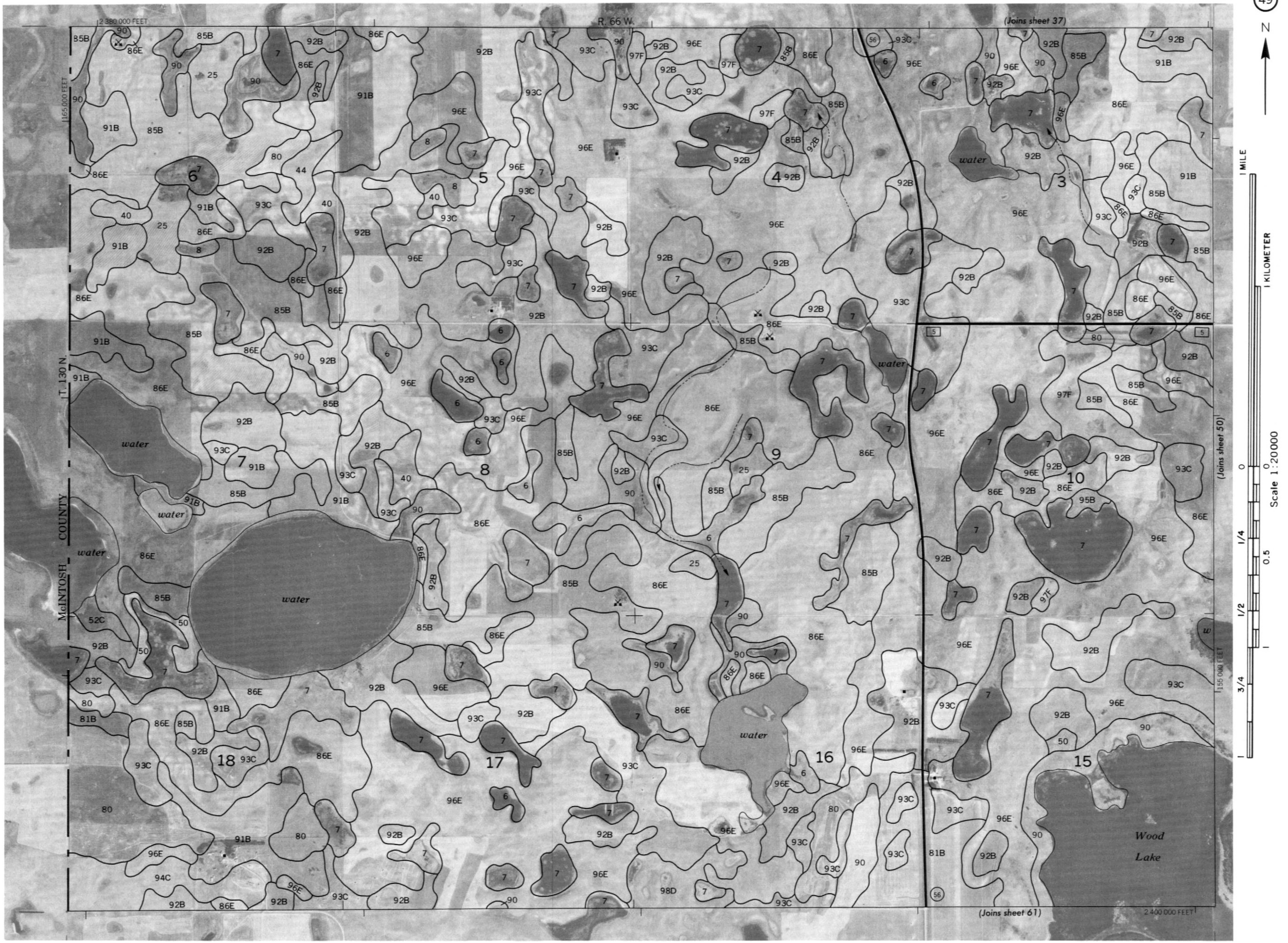
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 47

47

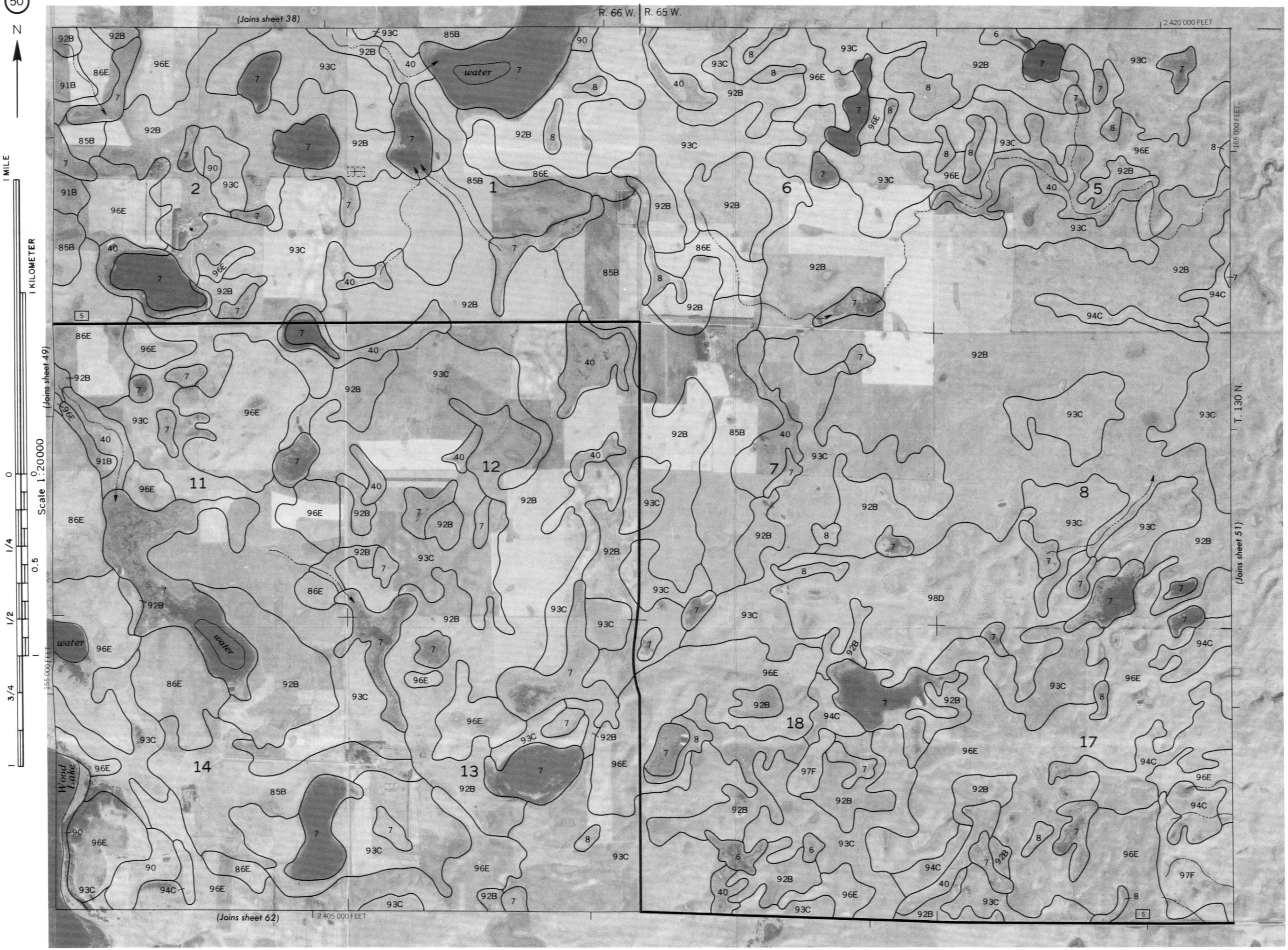

N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 36)
R. 59 W.
2 630 000 FEET
BURLINGTON NORTHERN
SOO LINE
OAKS
(Joins sheet 47)
OAKS VIEW CEMETERY
T. 131 N.
SARGENT COUNTY
(Joins sheet 60)
2 615 000 FEET
21
22
23
24
25
26
27
28
33
34
35
36

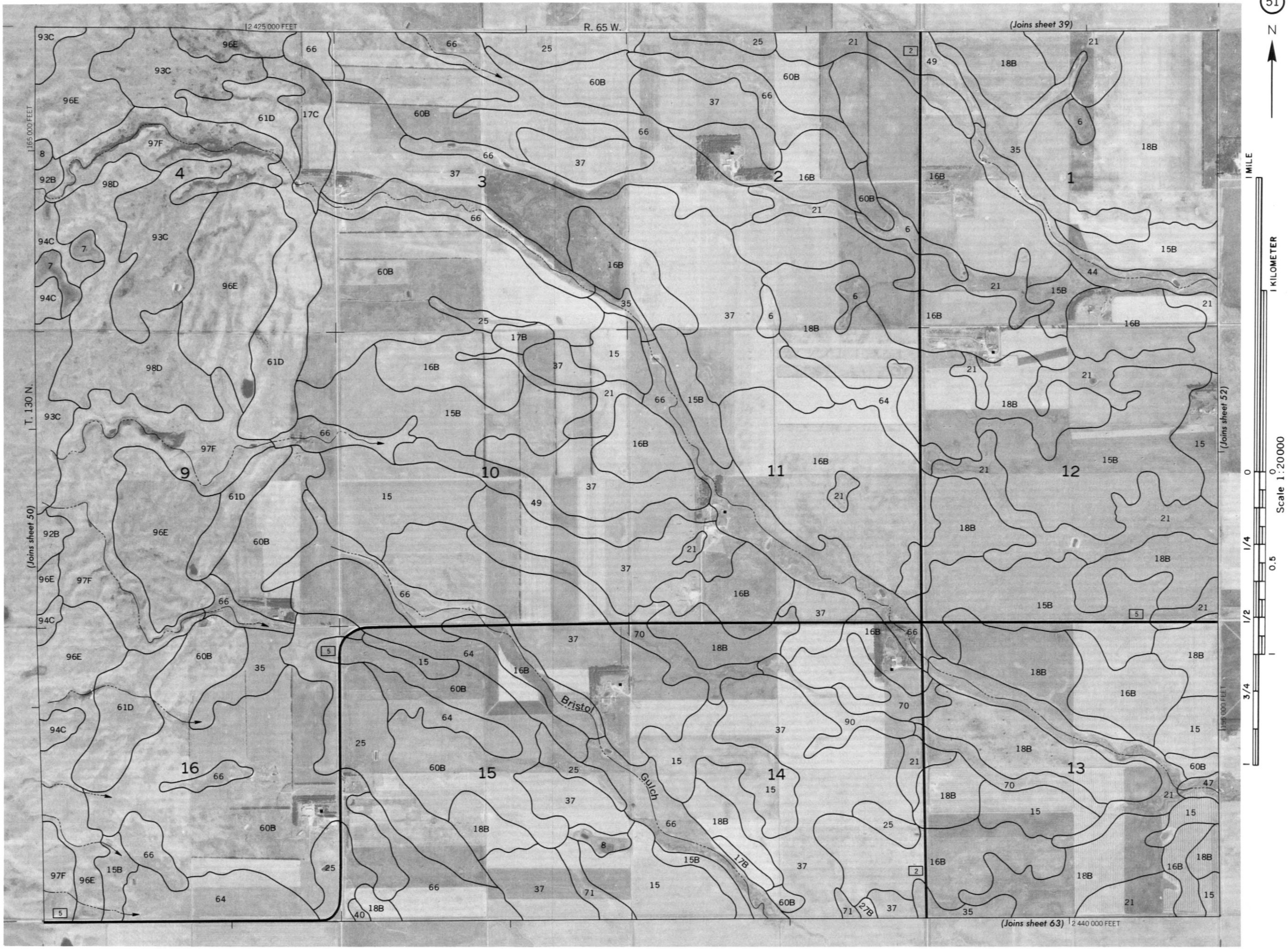
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 49

49

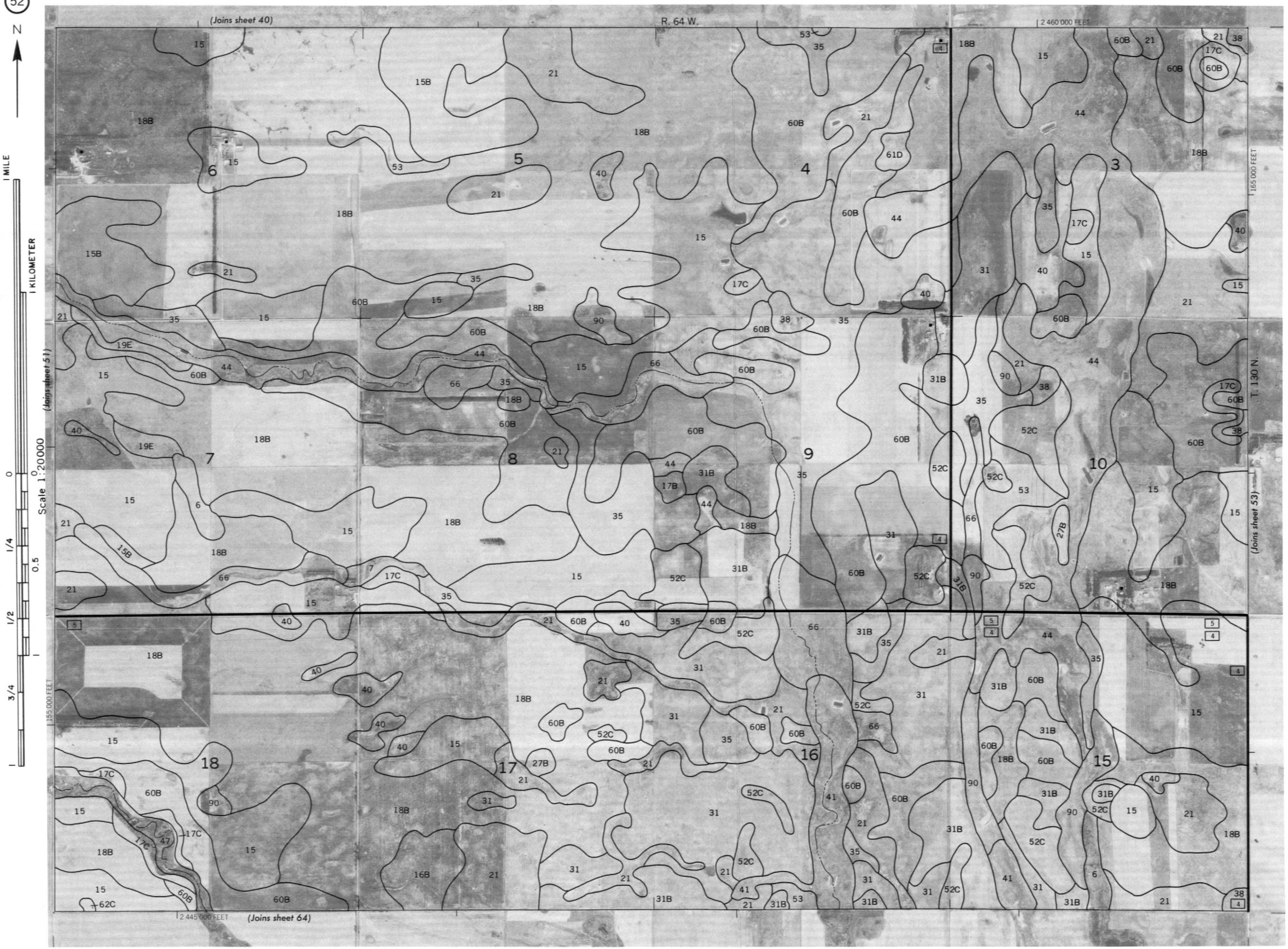


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 50

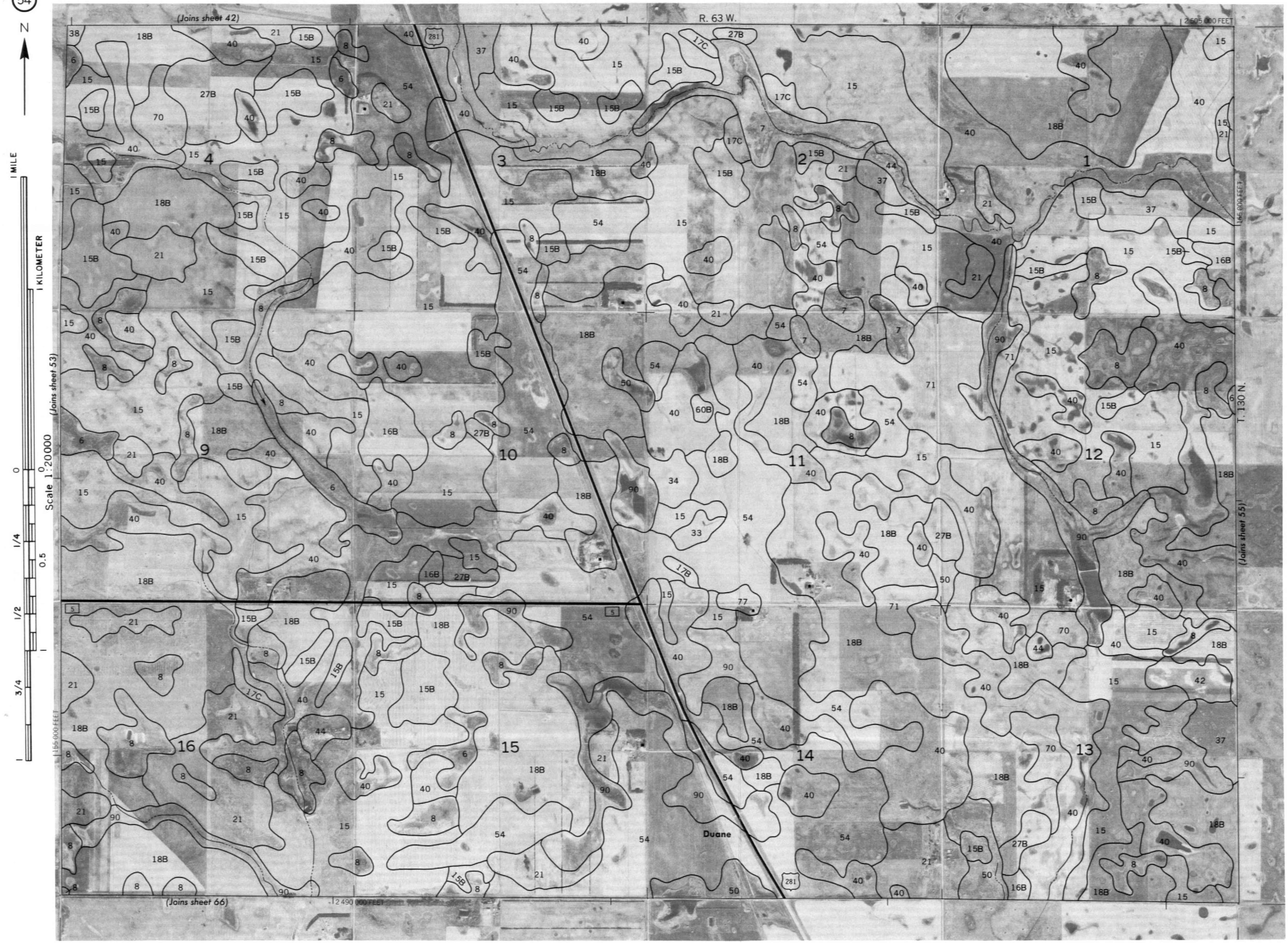



R. 65 W.
(Joins sheet 39)
(Joins sheet 50)
(Joins sheet 52)
(Joins sheet 63)
T. 130 N.
2 425 000 FEET
2 440 000 FEET
165 000 FEET
150 000 FEET
Bristol
Gulch
N
1 MILE
1 KILOMETER
Scale 1:20000

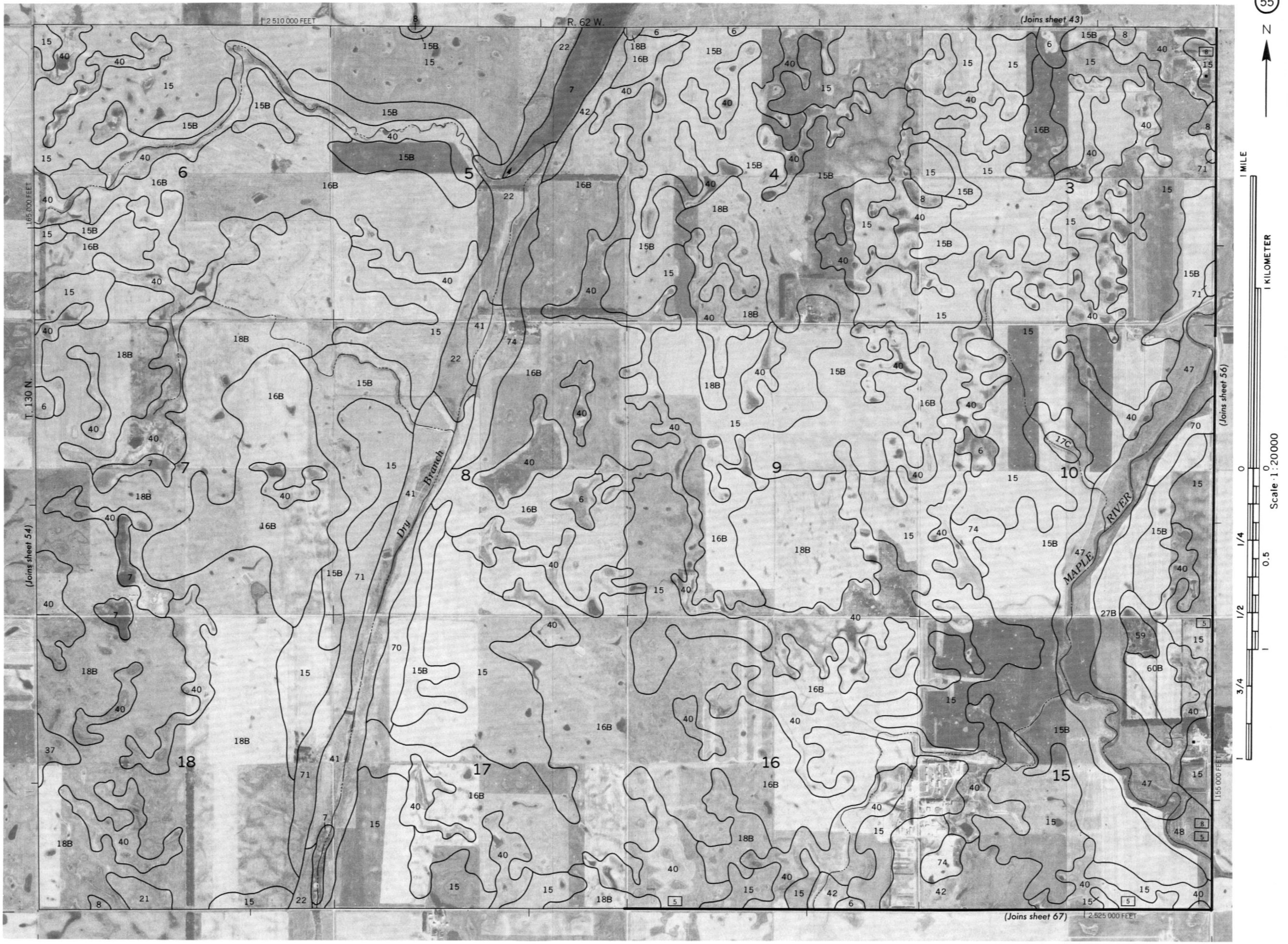
52


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
(Joins sheet 40)
R. 64 W.
2 460 000 FEET
165 000 FEET
T. 130 N.
(Joins sheet 51)
(Joins sheet 53)
155 000 FEET
2 445 000 FEET
(Joins sheet 64)
3
4
5
6
7
8
9
10
15
16
17
18

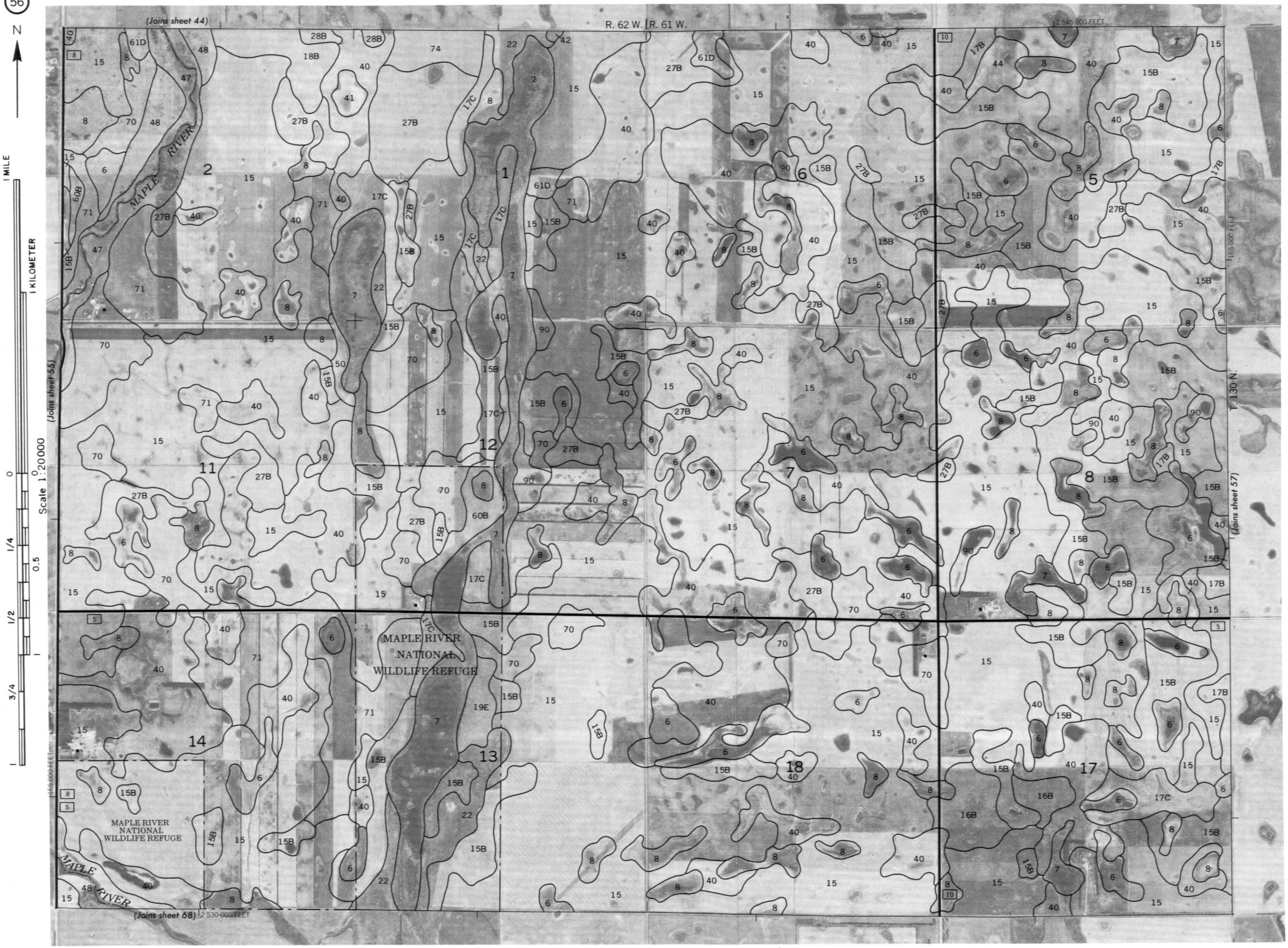
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 53


N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
(Joins sheet 42)
R. 63 W.
2 505 000 FEET
(Joins sheet 53)
(Joins sheet 55)
T. 130 N.
(Joins sheet 66)
2 490 000 FEET
165 000 FEET
166 000 FEET
281
5
Duane

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 55

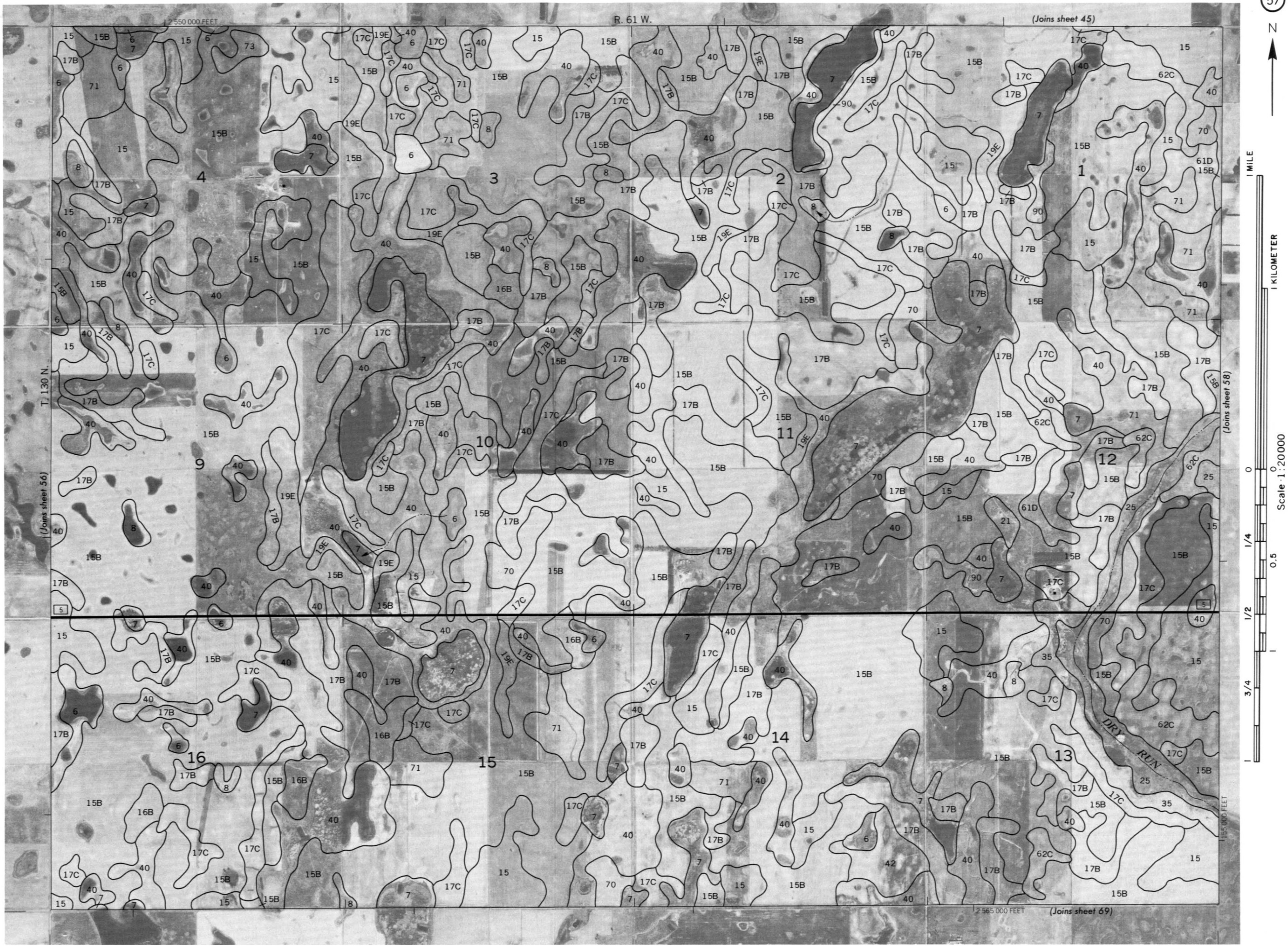


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 56

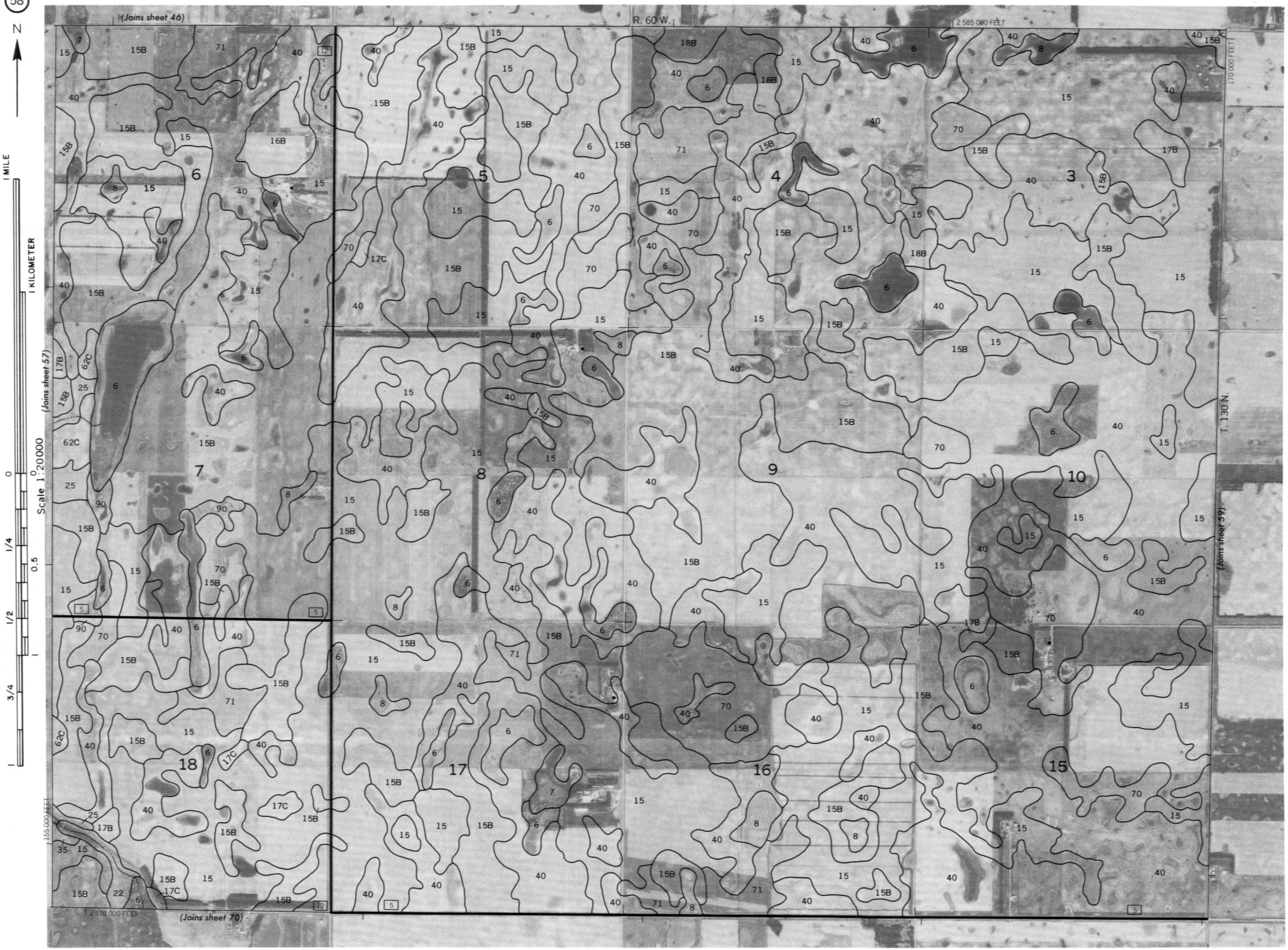


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 57

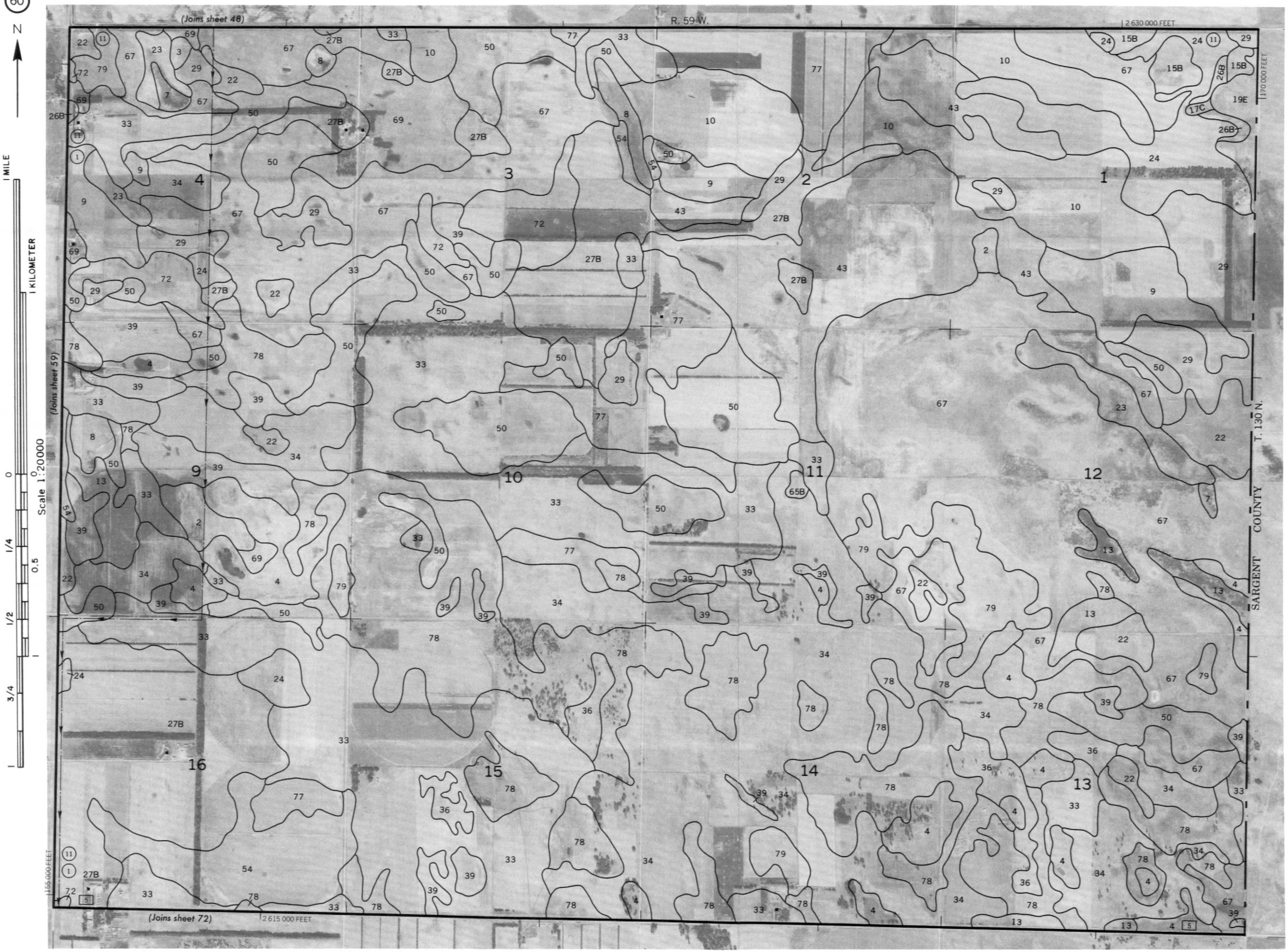
57

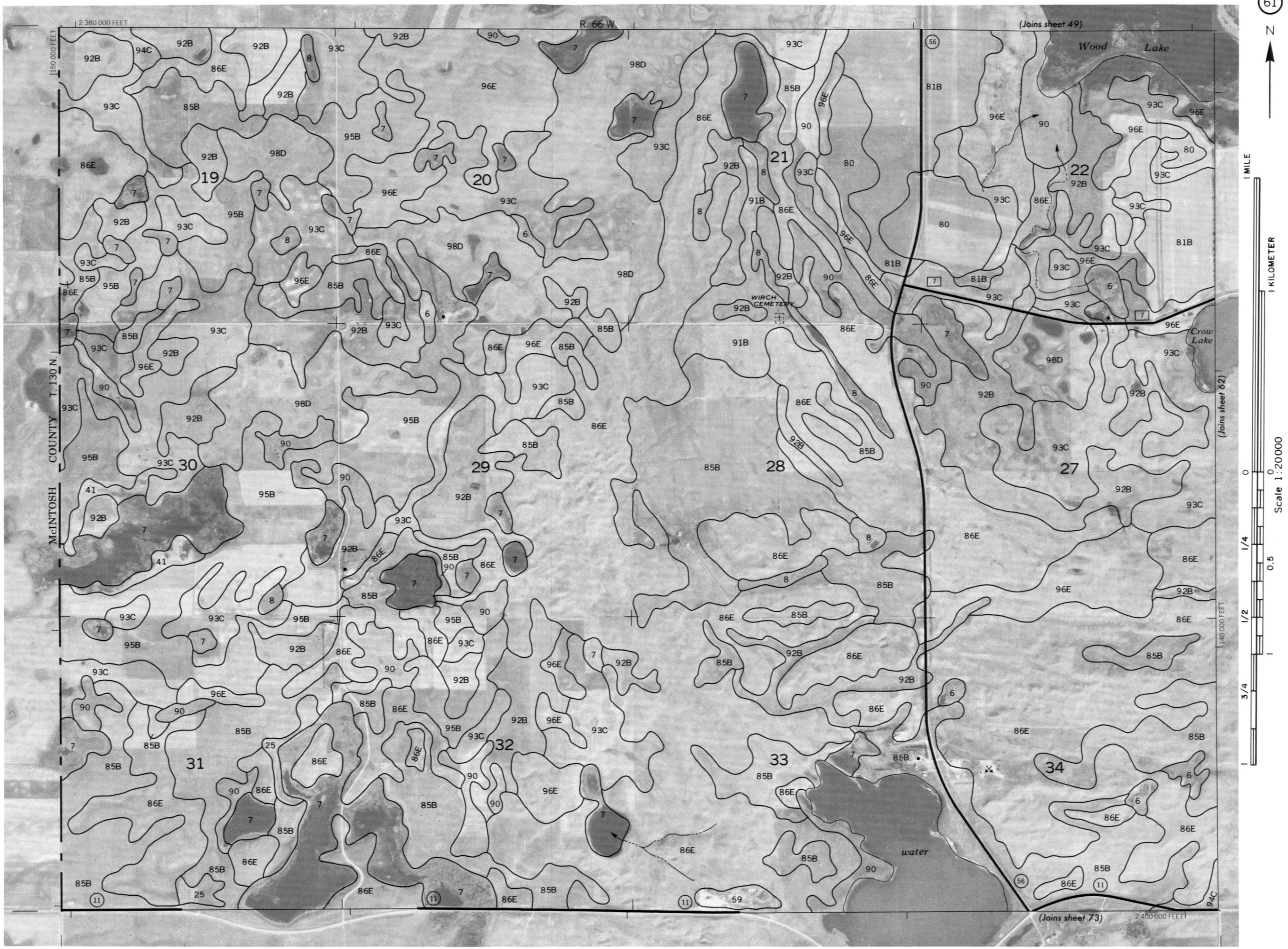


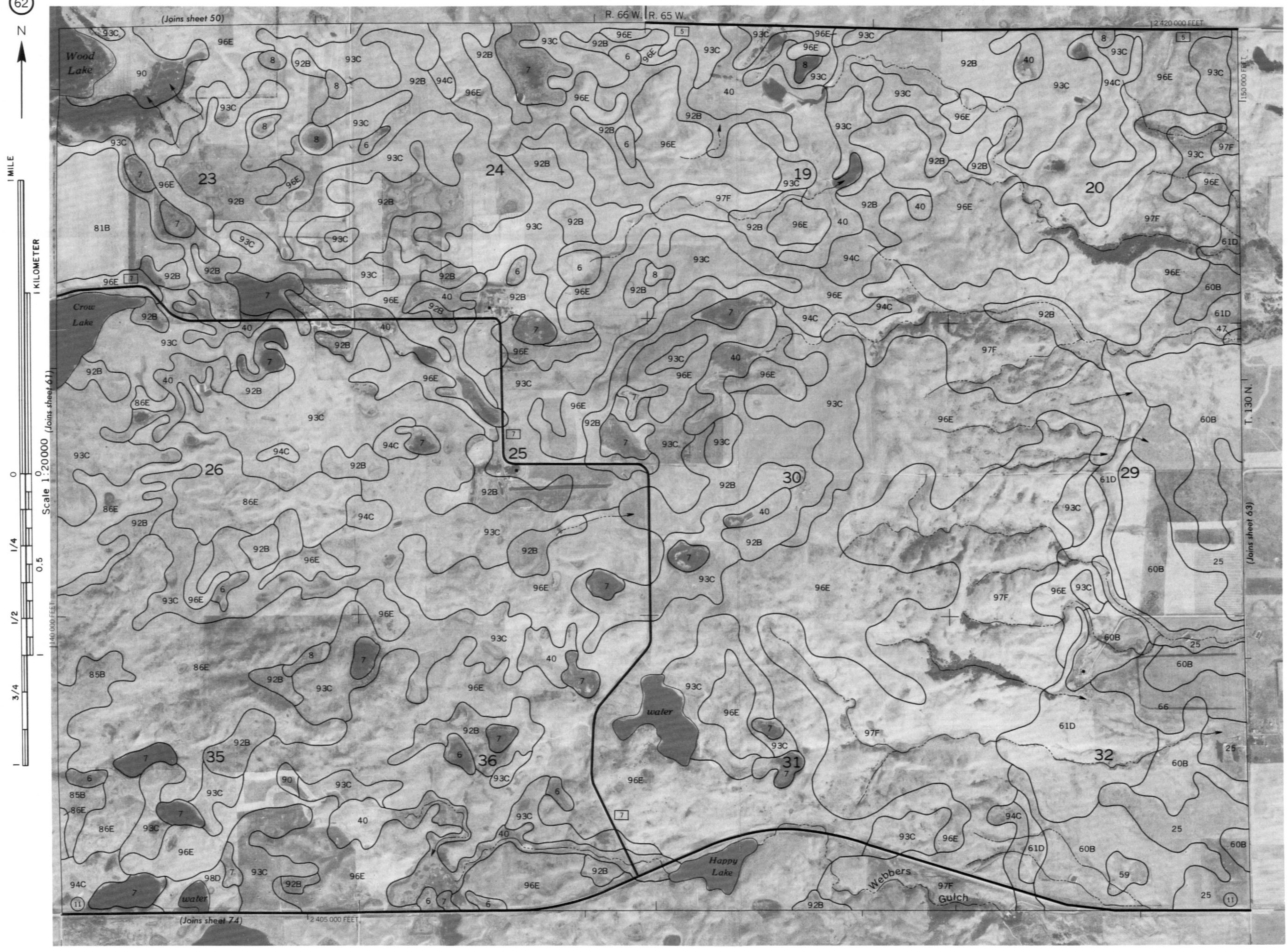
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 58



SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 59


N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 48)
R. 59 W.
2 630 000 FEET
170 000 FEET
(Joins sheet 59)
T. 130 N.
SARGENT COUNTY
(Joins sheet 72)
2 615 000 FEET
155 000 FEET

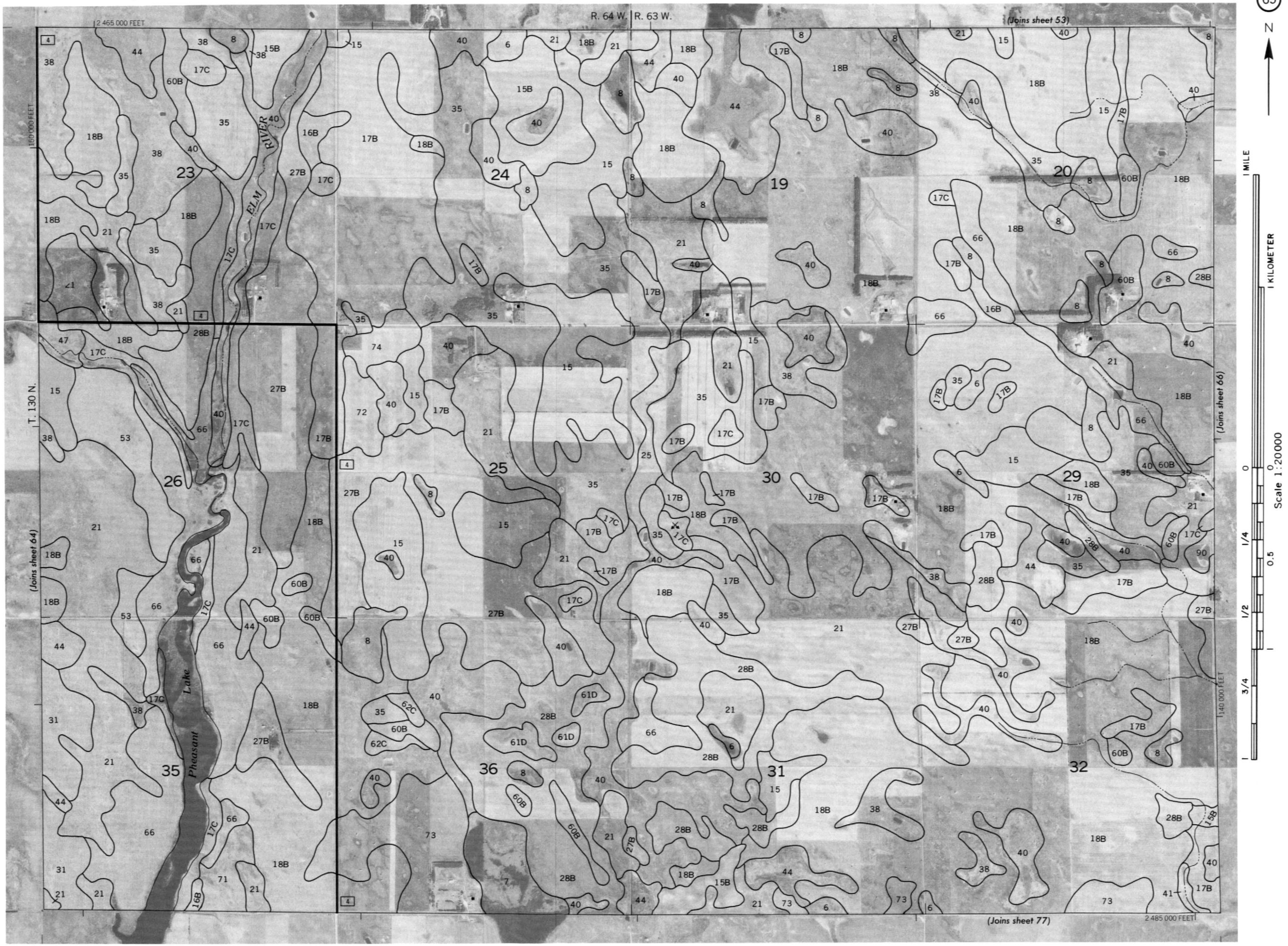

61
N
(Joins sheet 49)
(Joins sheet 62)
(Joins sheet 73)
R. 66 W.
T. 130 N.
McINTOSH COUNTY
2 380 000 FEET
2 400 000 FEET
150 000 FEET
140 000 FEET
Wood Lake
Crow Lake
WIRCH CEMETERY
water
1 MILE
1 KILOMETER
Scale 1:20000


N
(Joins sheet 50)
R. 66 W.
R. 65 W.
2 420 000 FEET
150 000 FEET
140 000 FEET
2 405 000 FEET
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 74)
T. 130 N.
Wood Lake
Crow Lake
Happy Lake
Webbers Gulch
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
19
20
23
24
25
26
29
30
31
32
35
36
6
7
8
25
40
47
59
60B
61D
66
81B
85B
86E
90
92B
93C
94C
96E
97F
98D

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 63

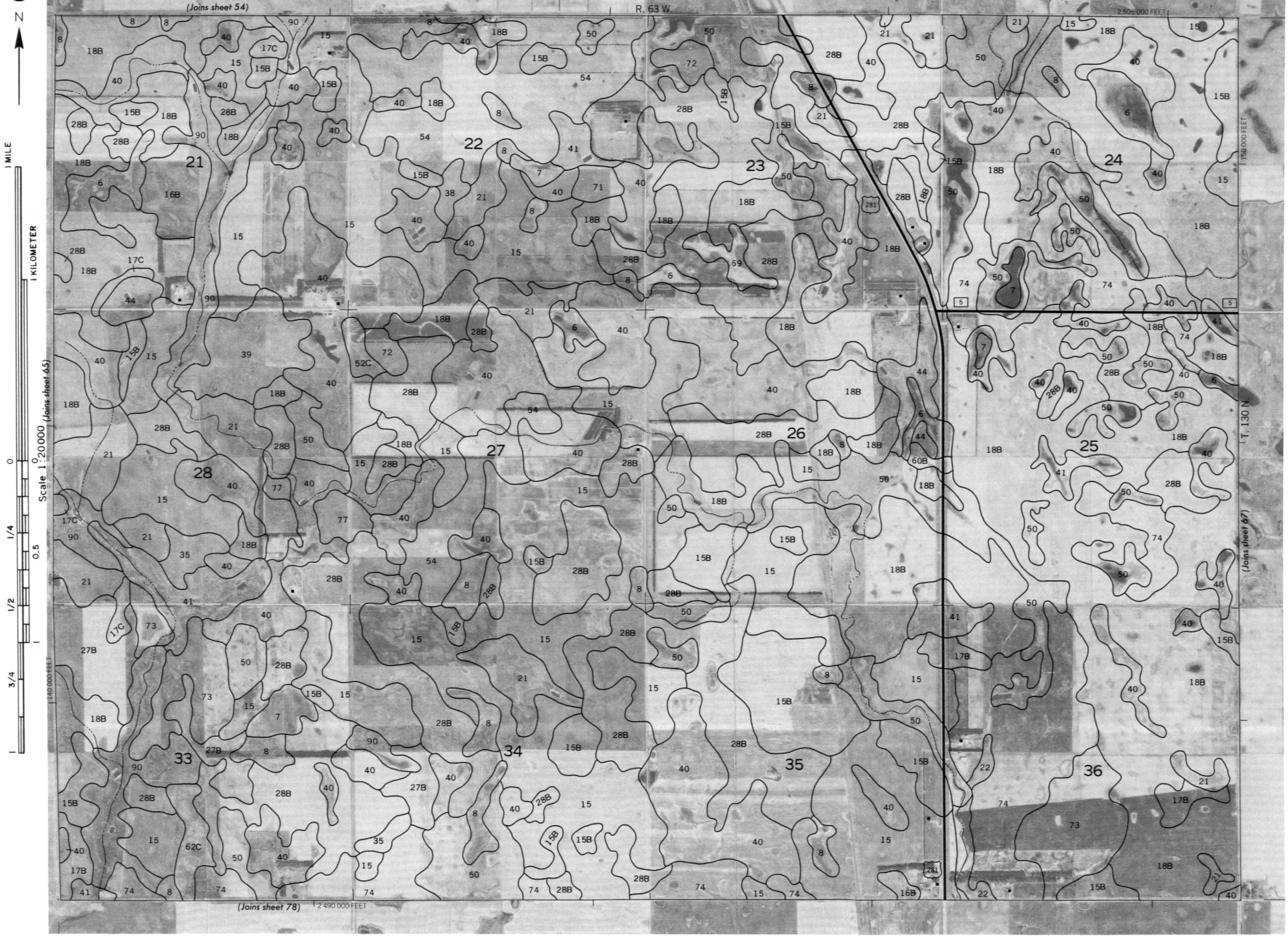
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 64

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 65

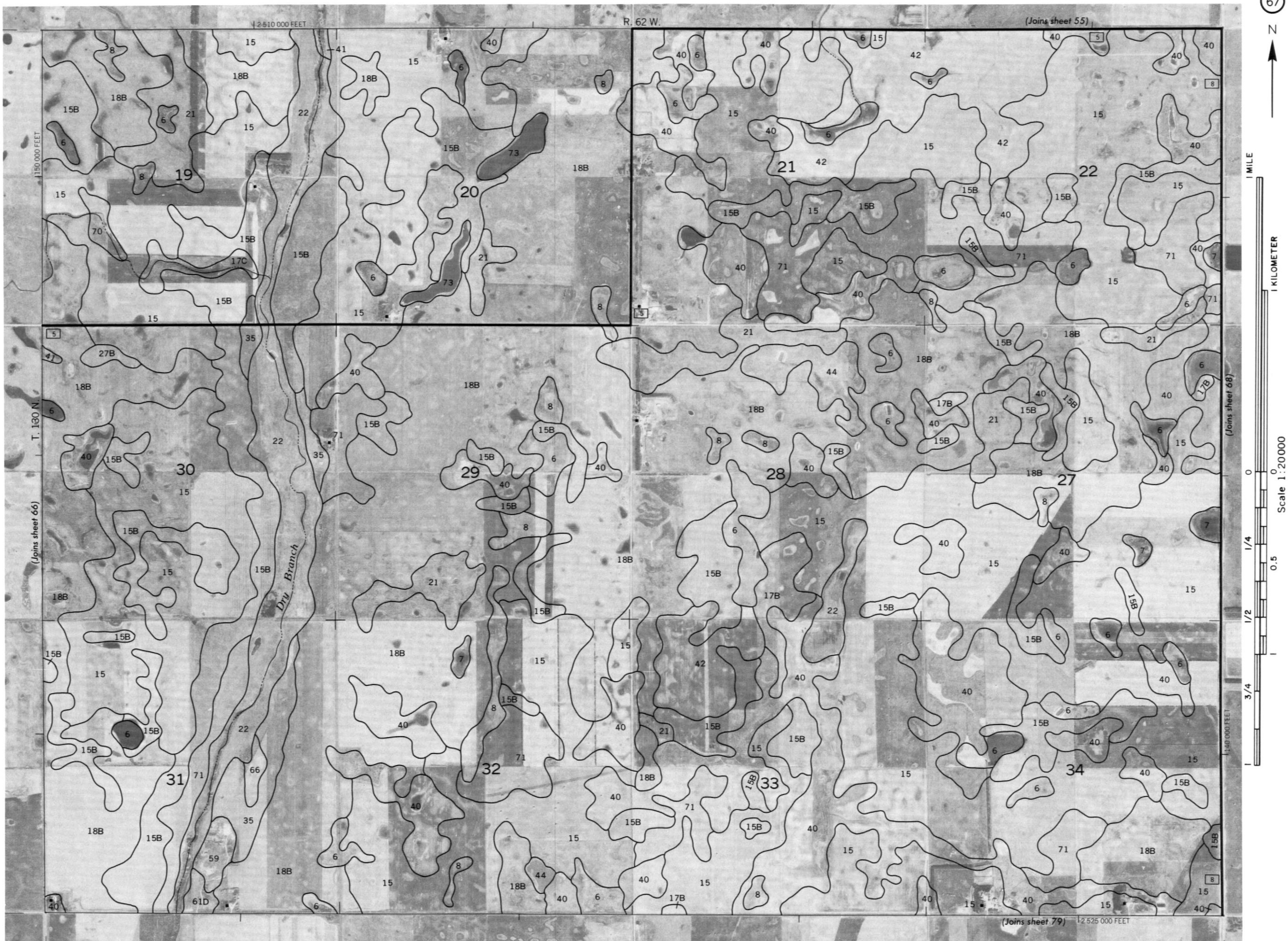


66

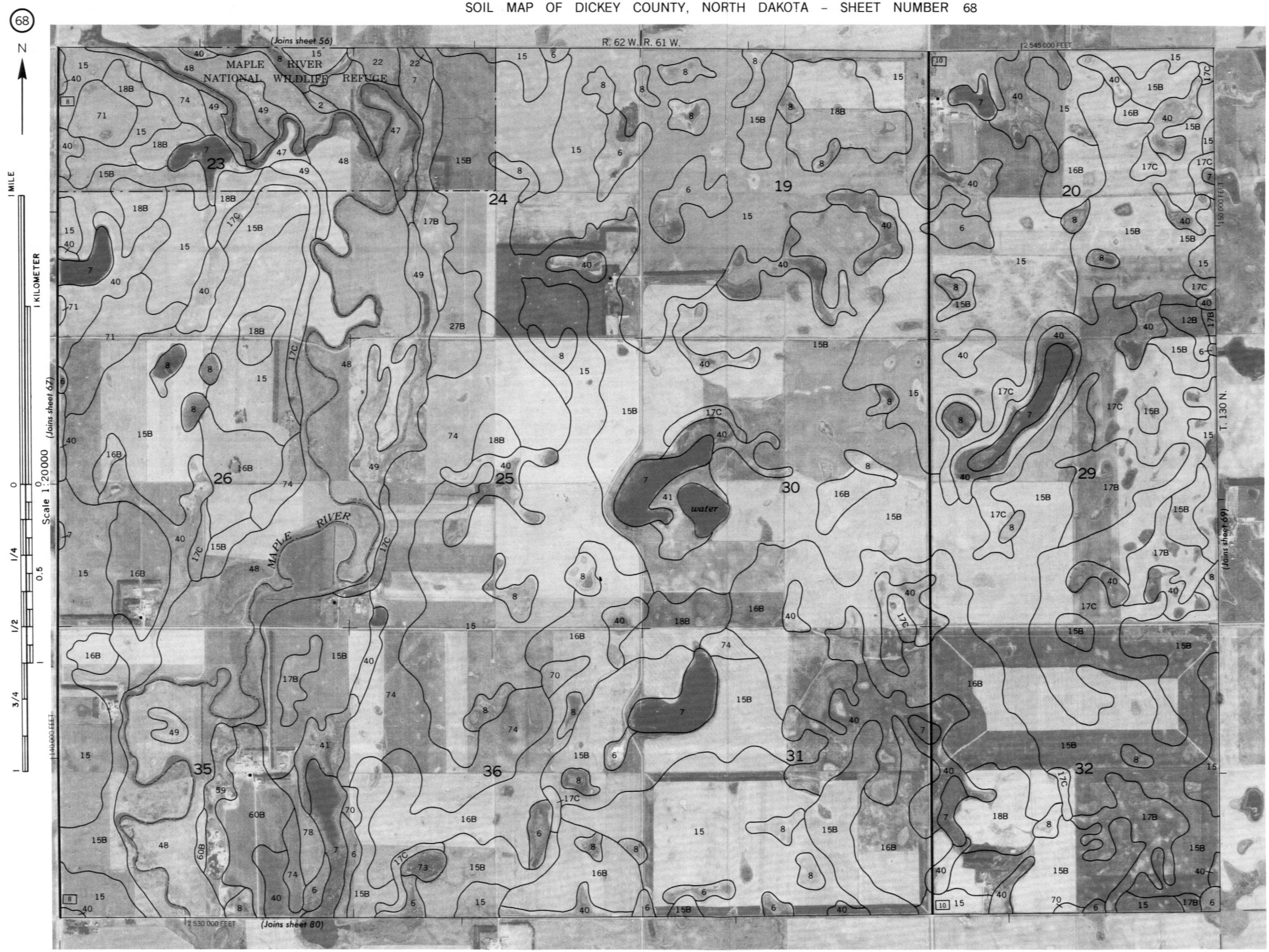
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 66



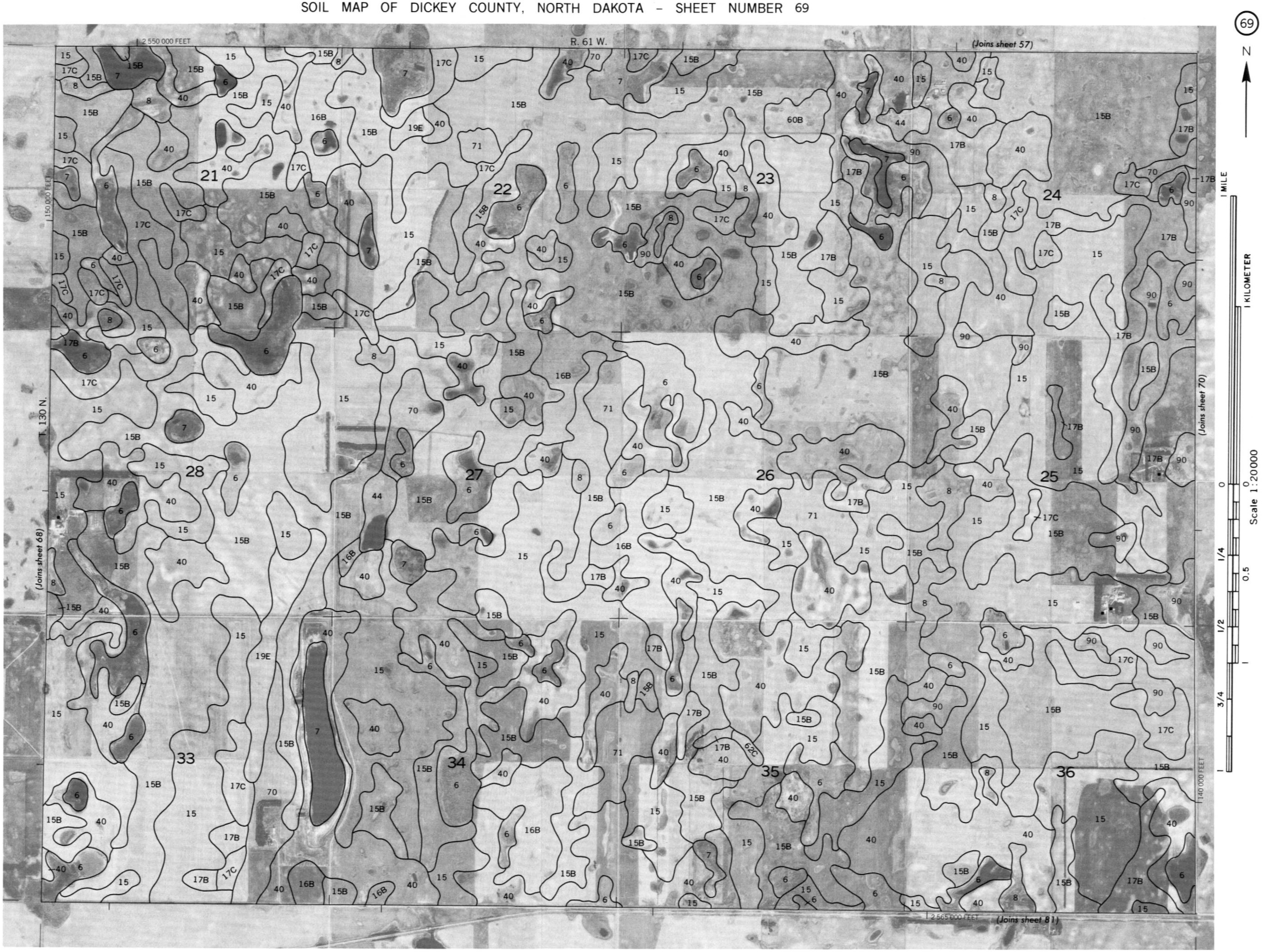
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 67



SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 68

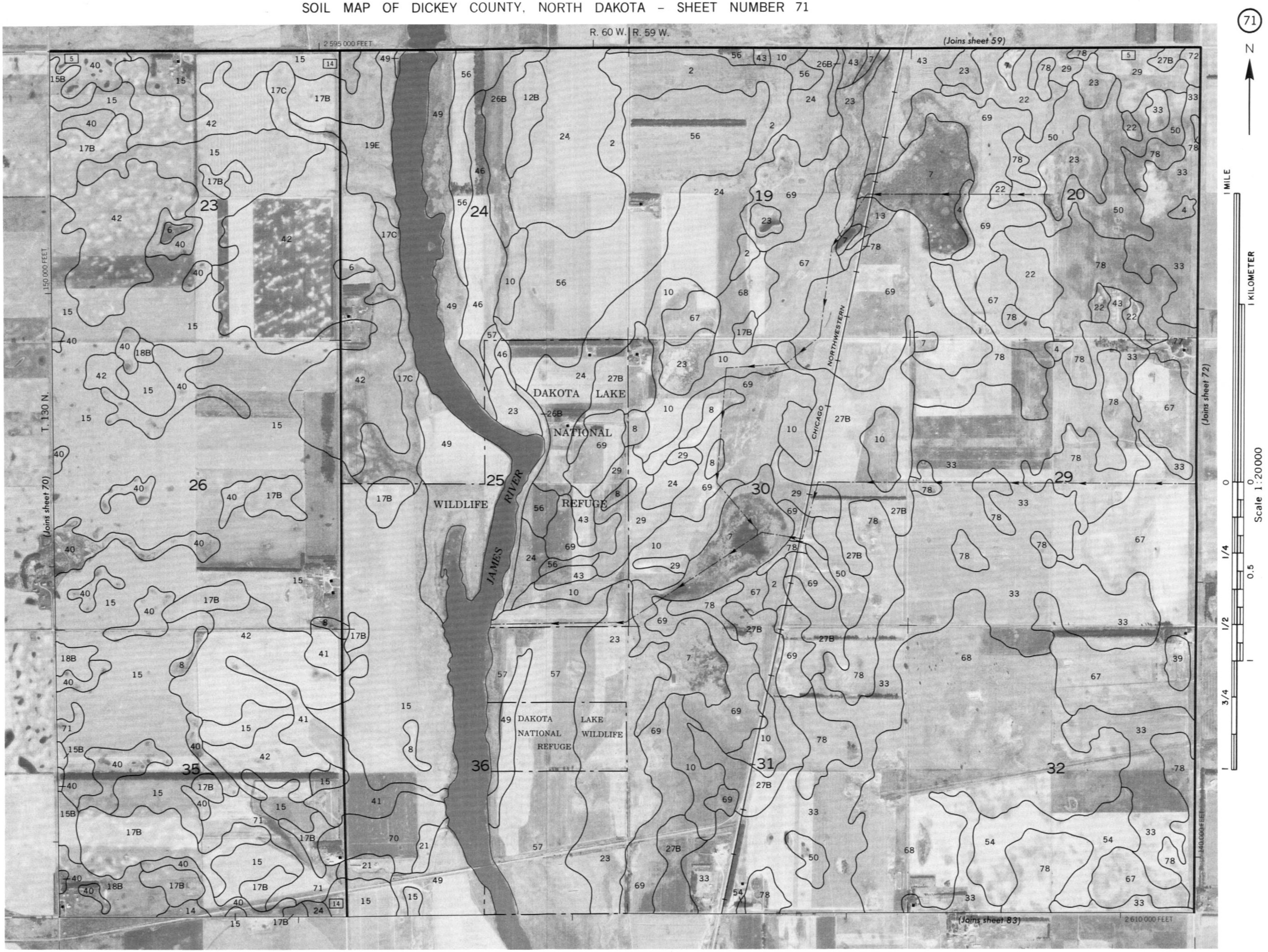


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 69

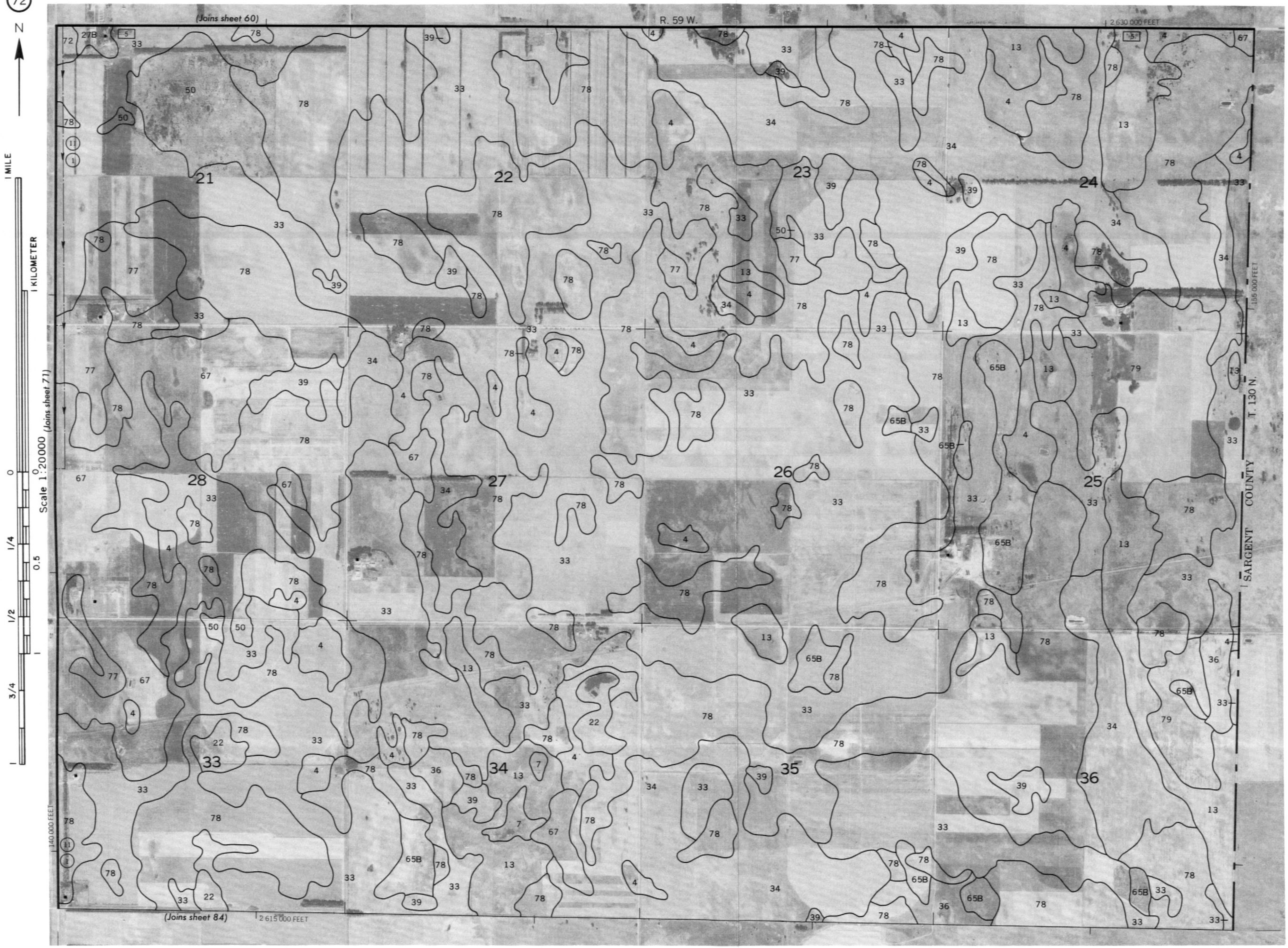



70
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 58)
R. 60 W.
2 590 000 FEET
150 000 FEET
T. 130 N.
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 82)
2 570 000 FEET
140 000 FEET
DRY RUN
Guelph
19
20
21
22
27
28
29
30
31
32
33
34

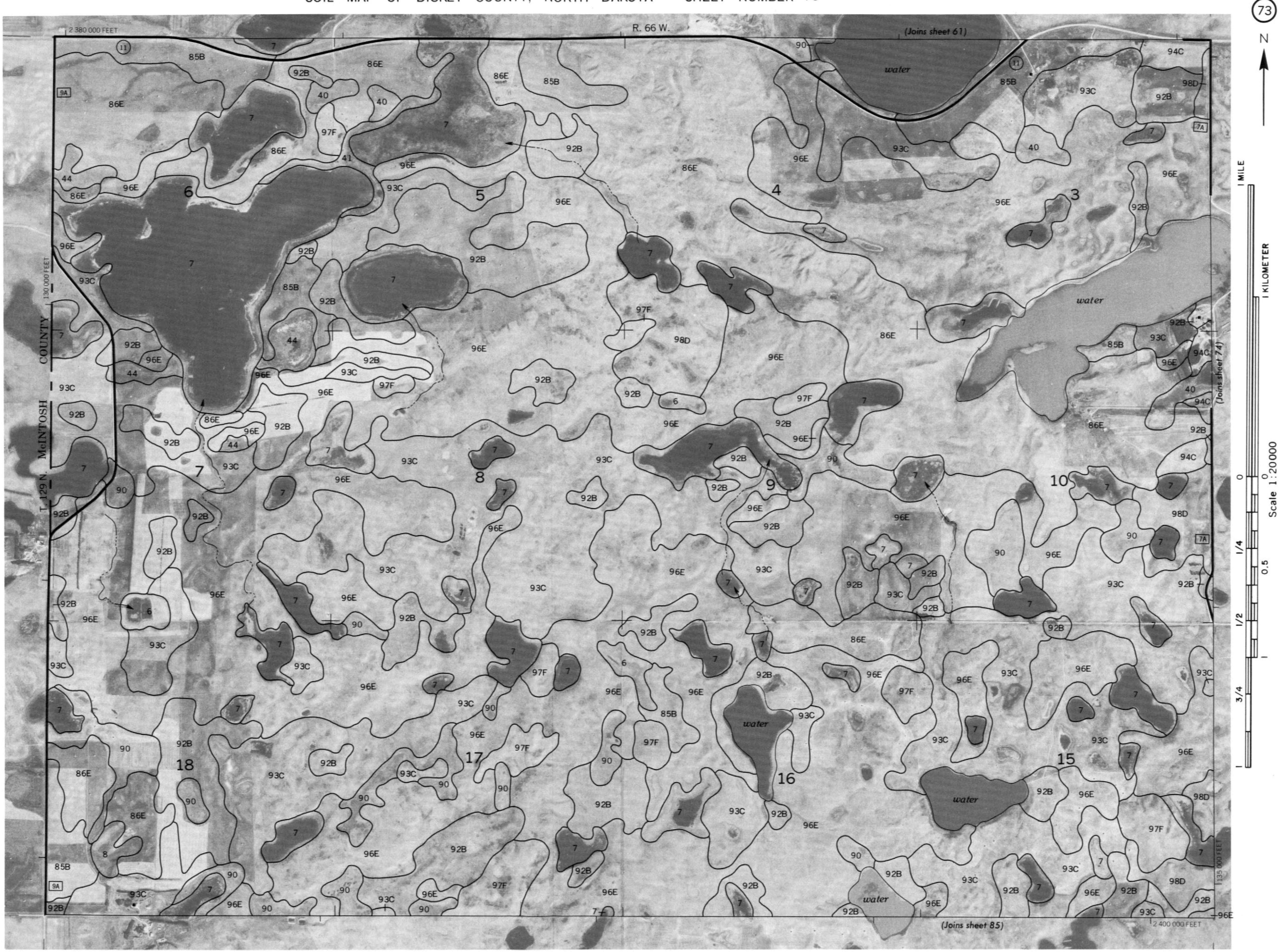
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 71



SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 72

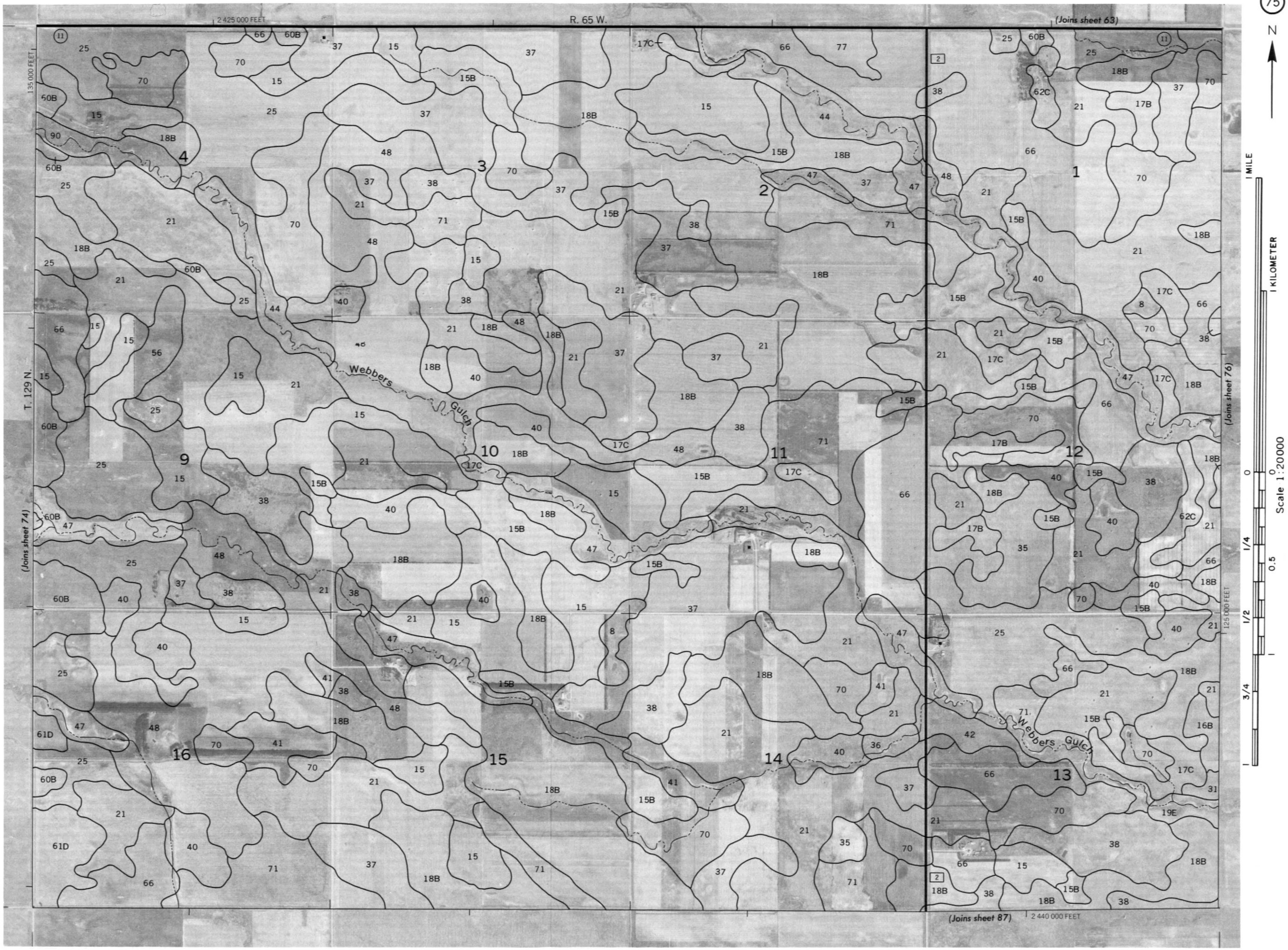


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 73



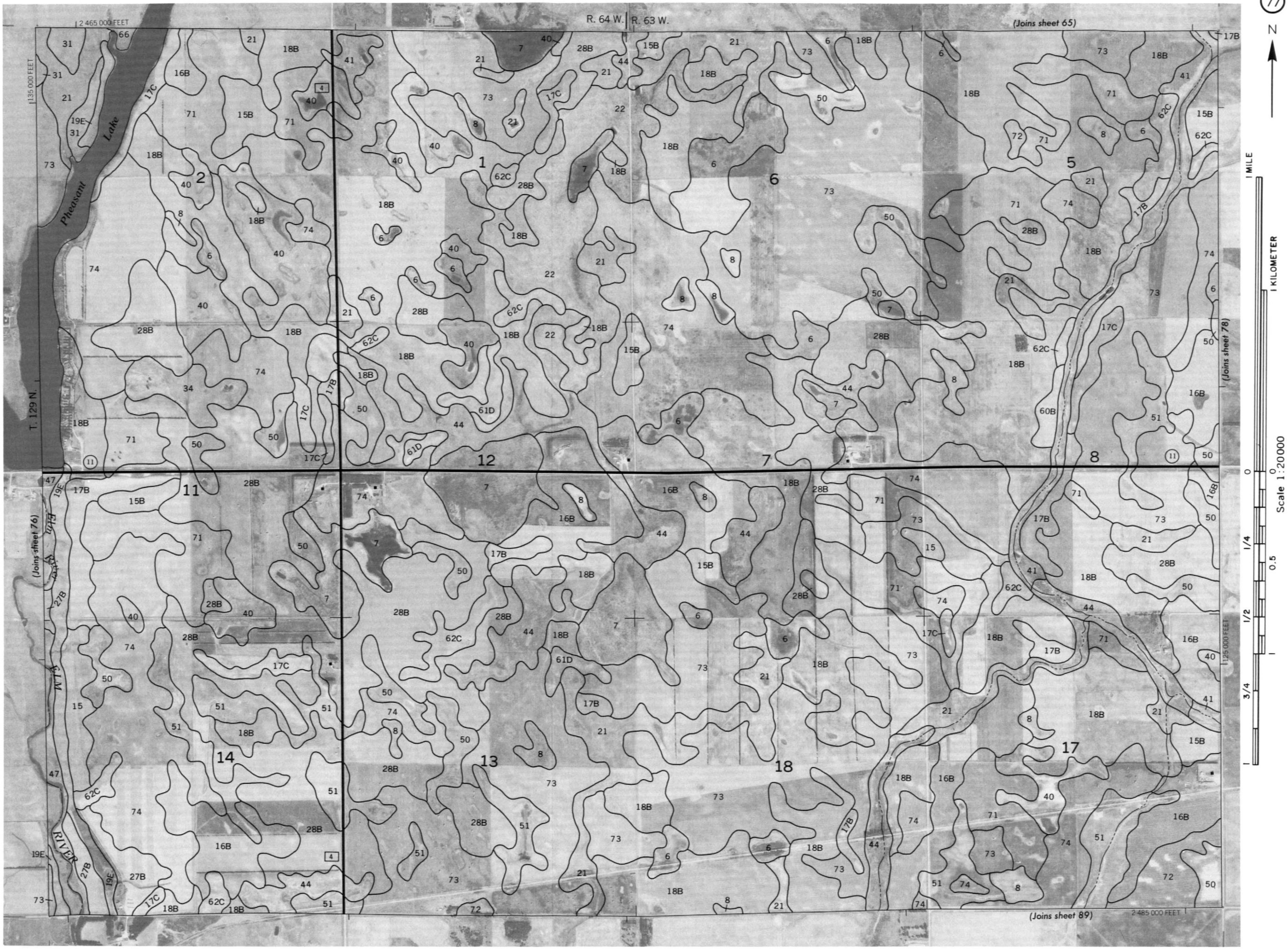
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 74

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 75

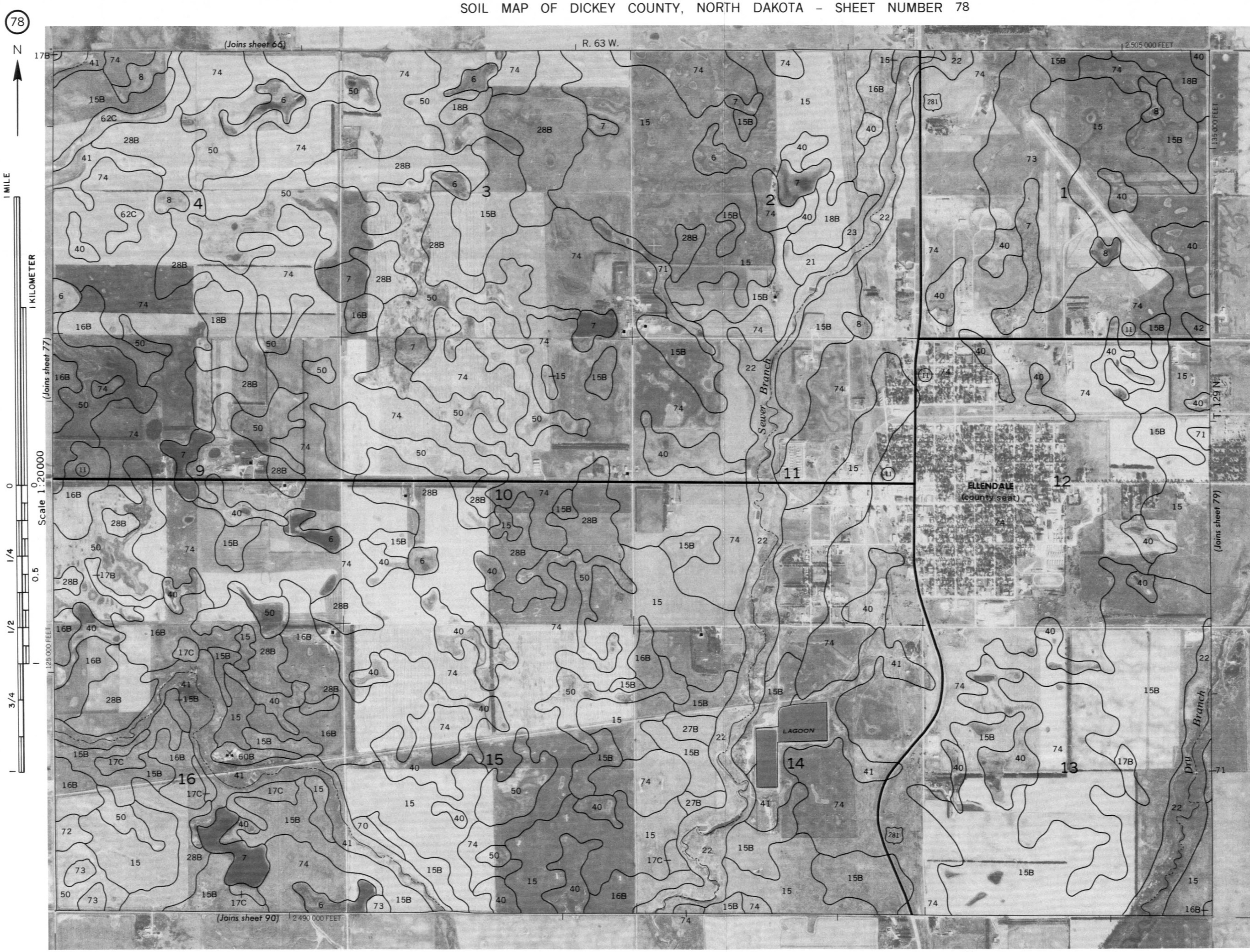


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 76

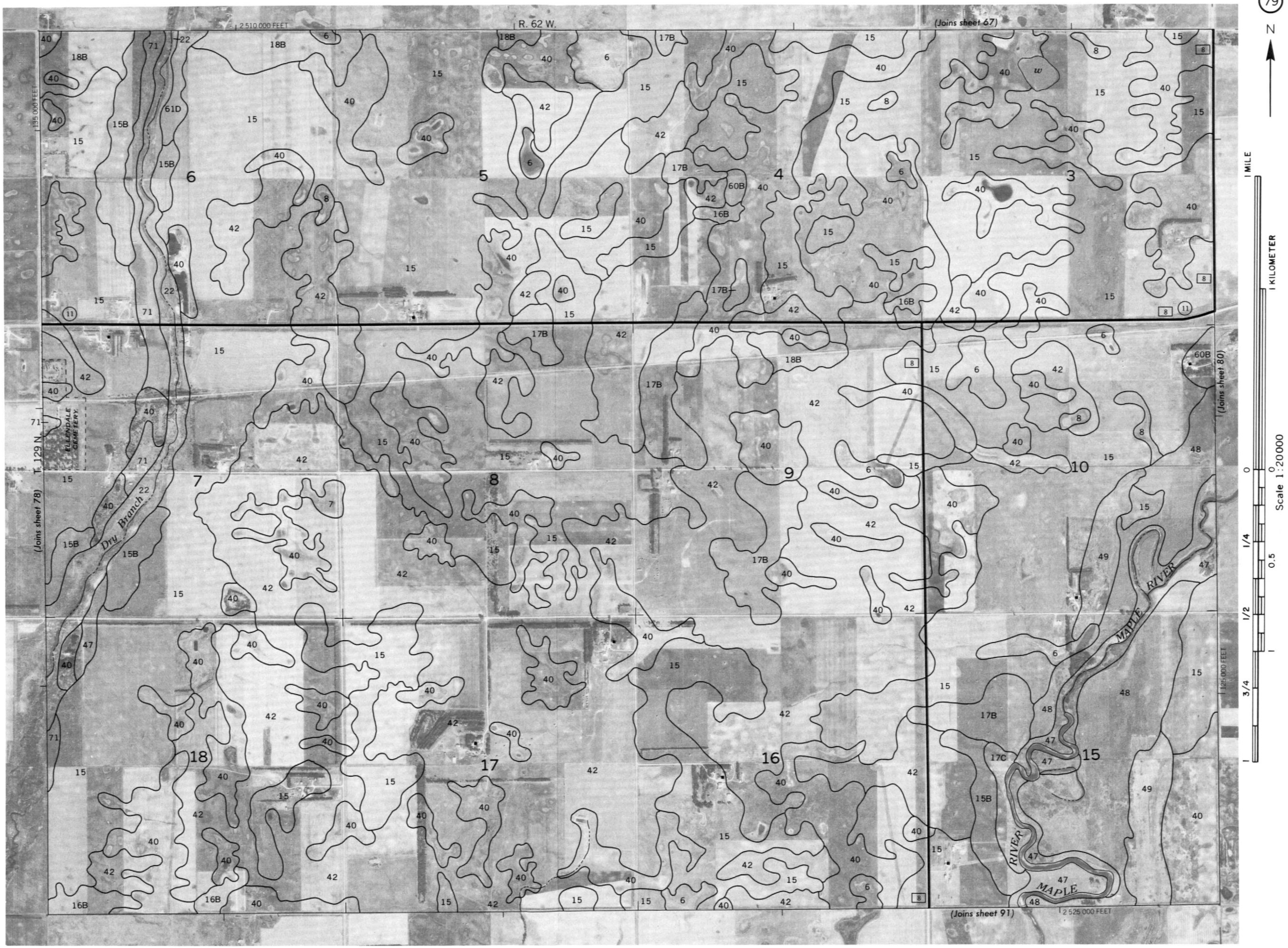
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 77



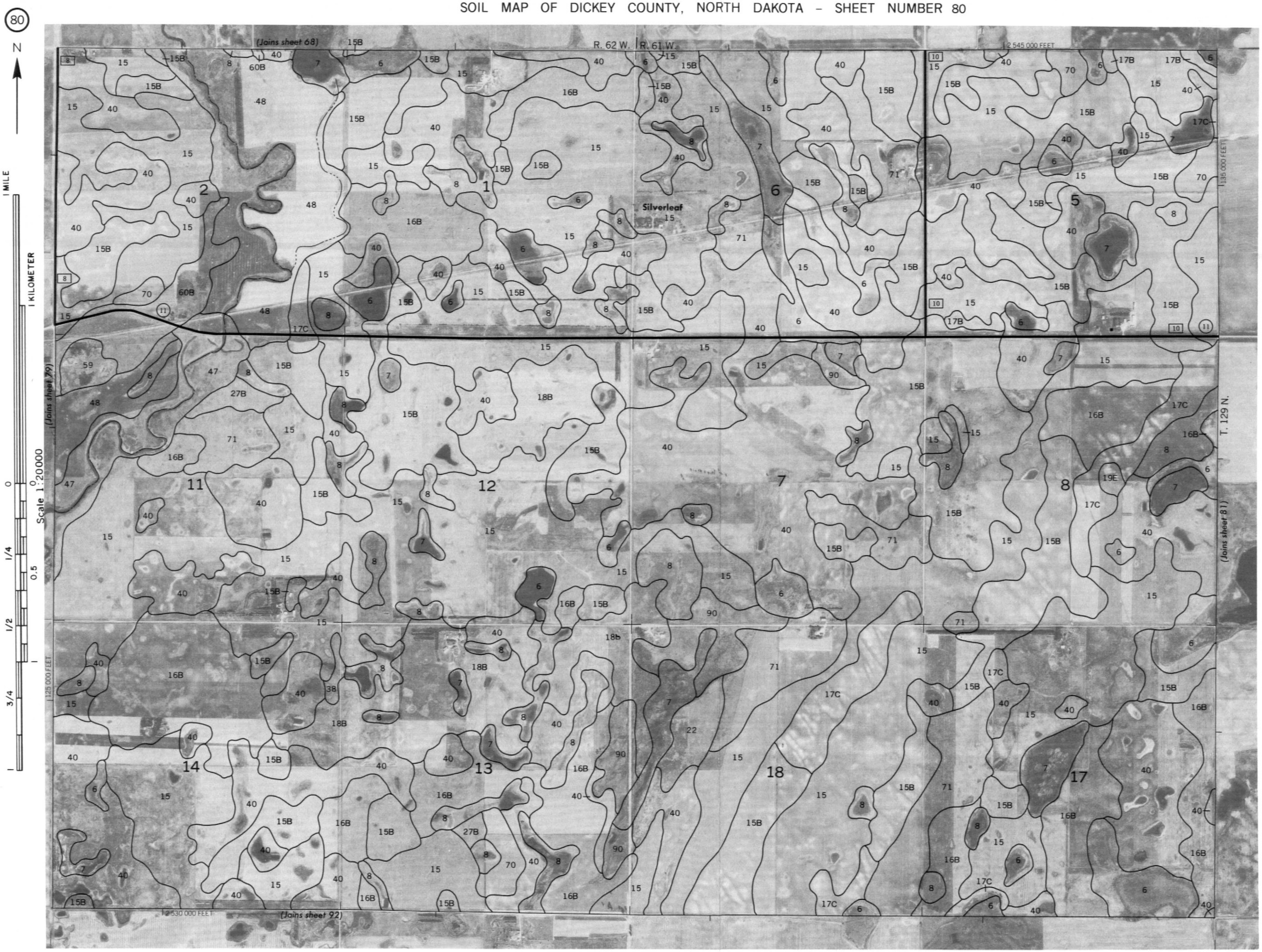
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 78



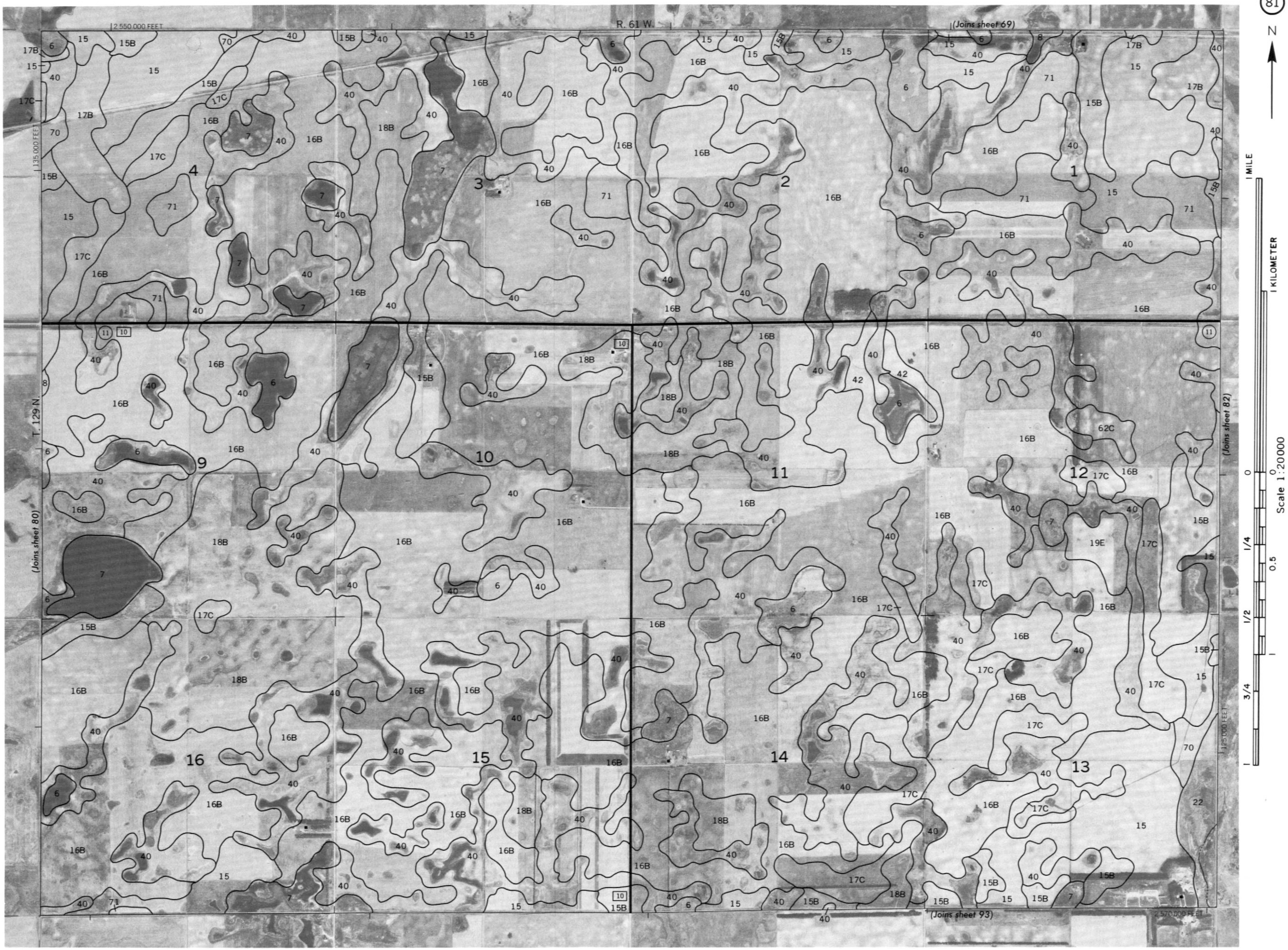
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 79



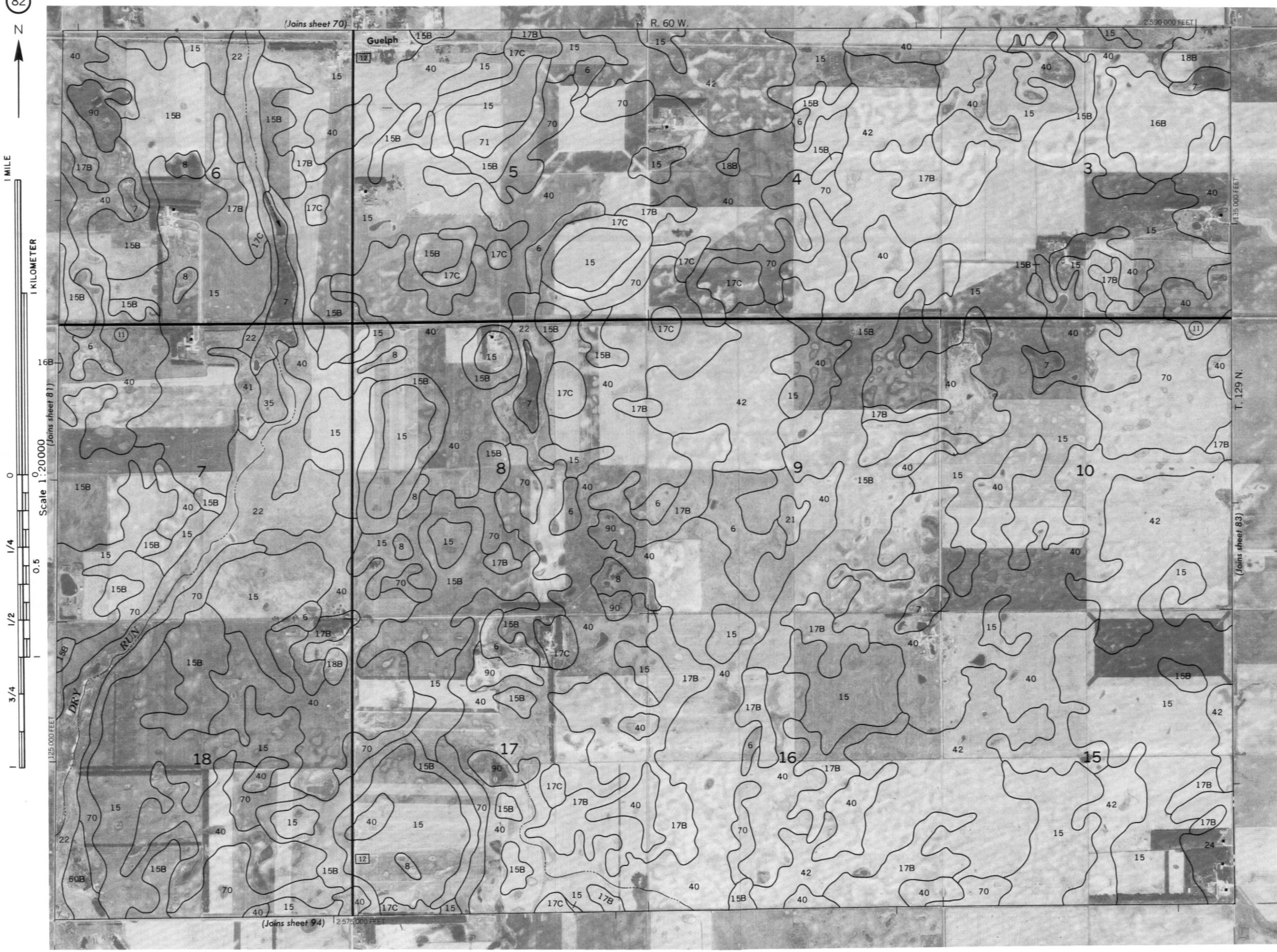
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 80



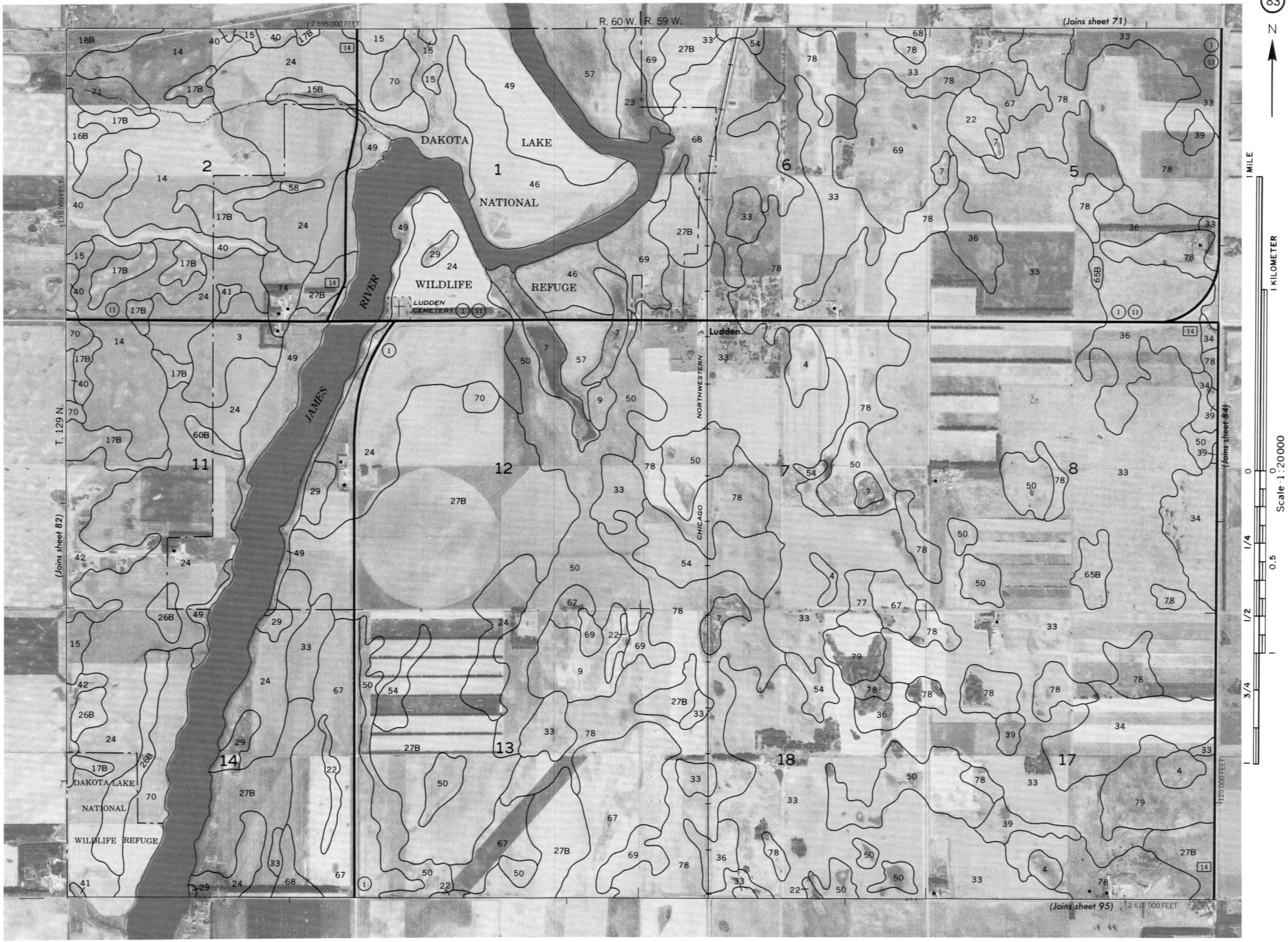
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 81



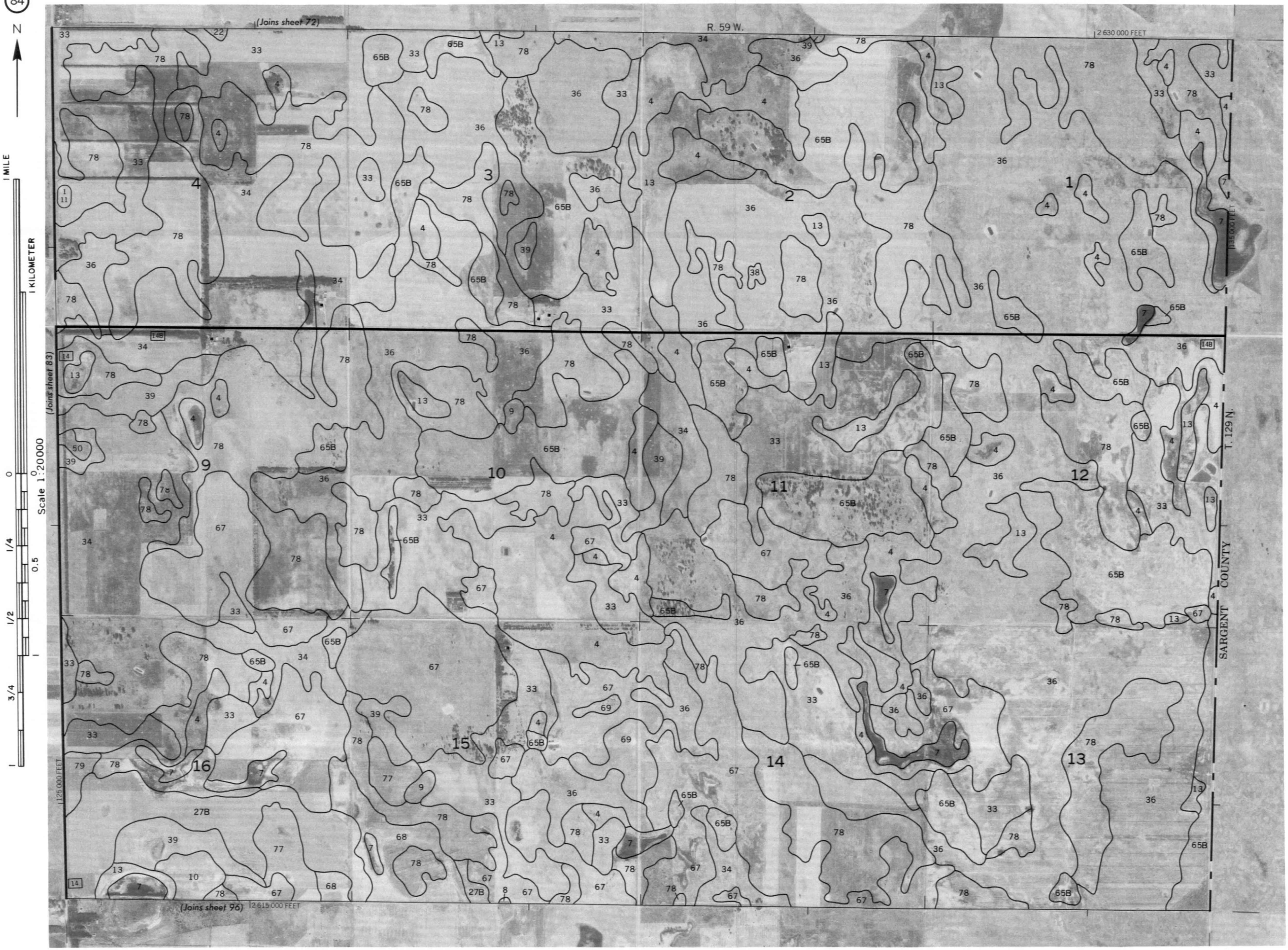
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 82



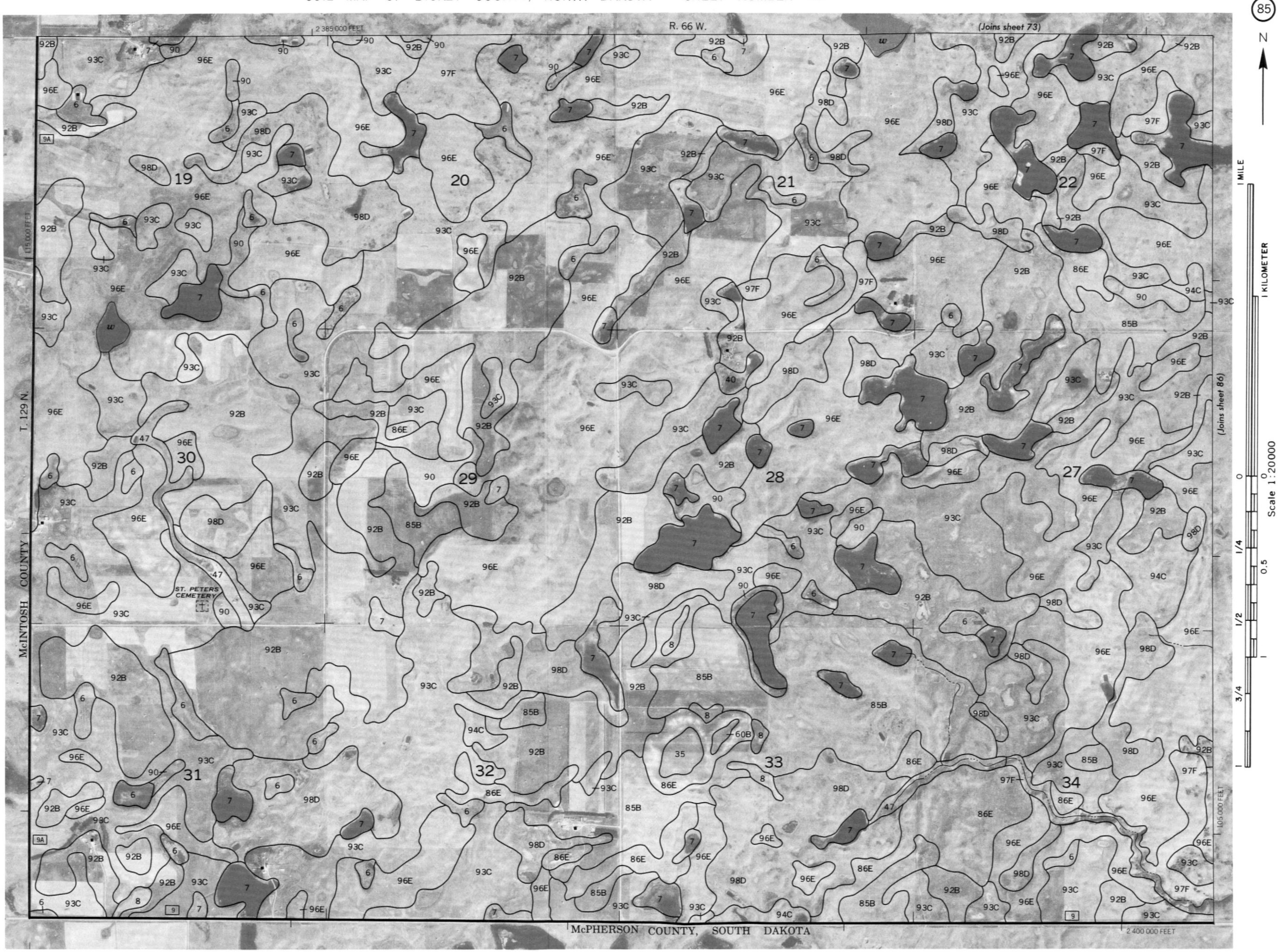
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 83



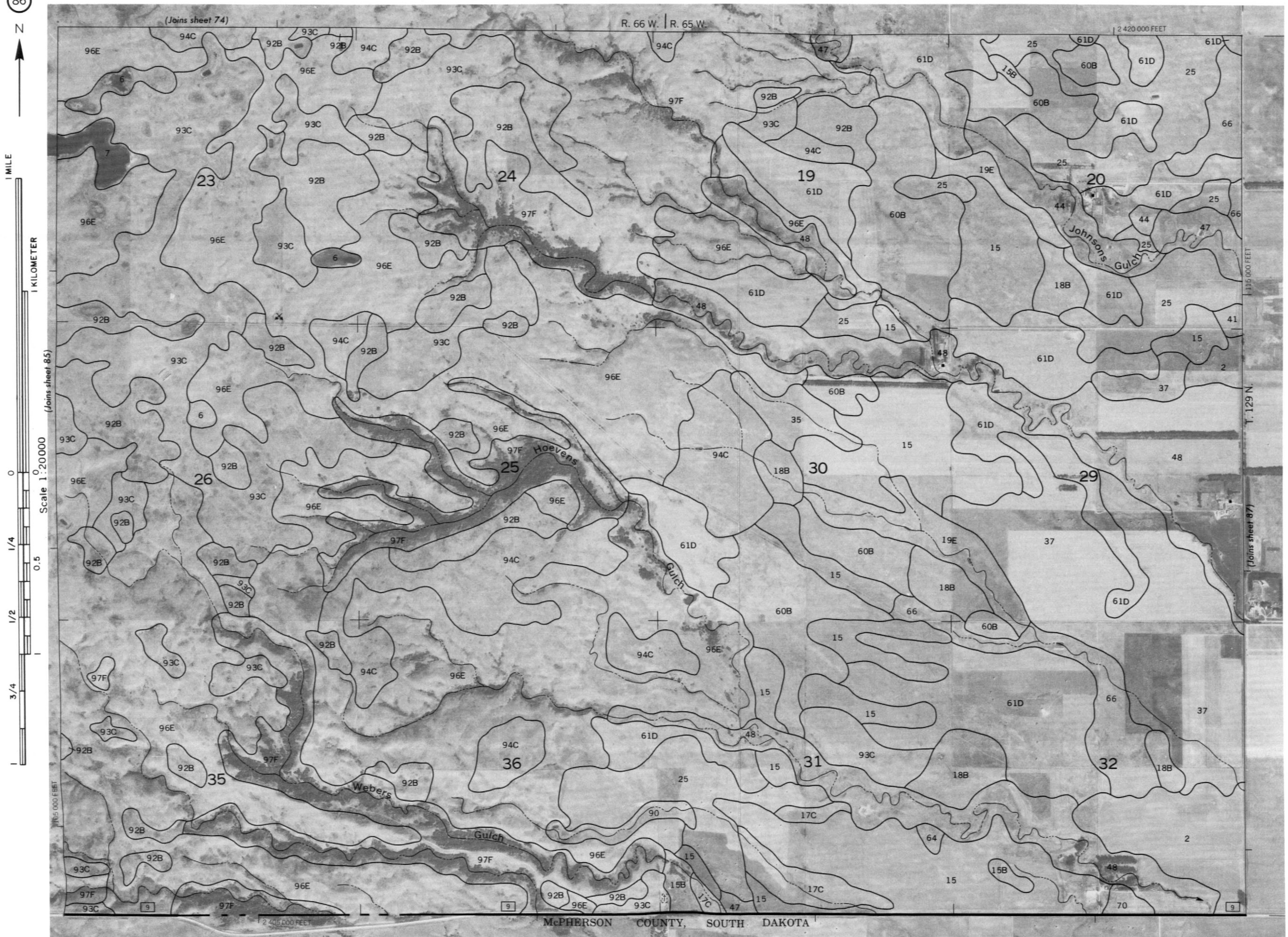
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 84



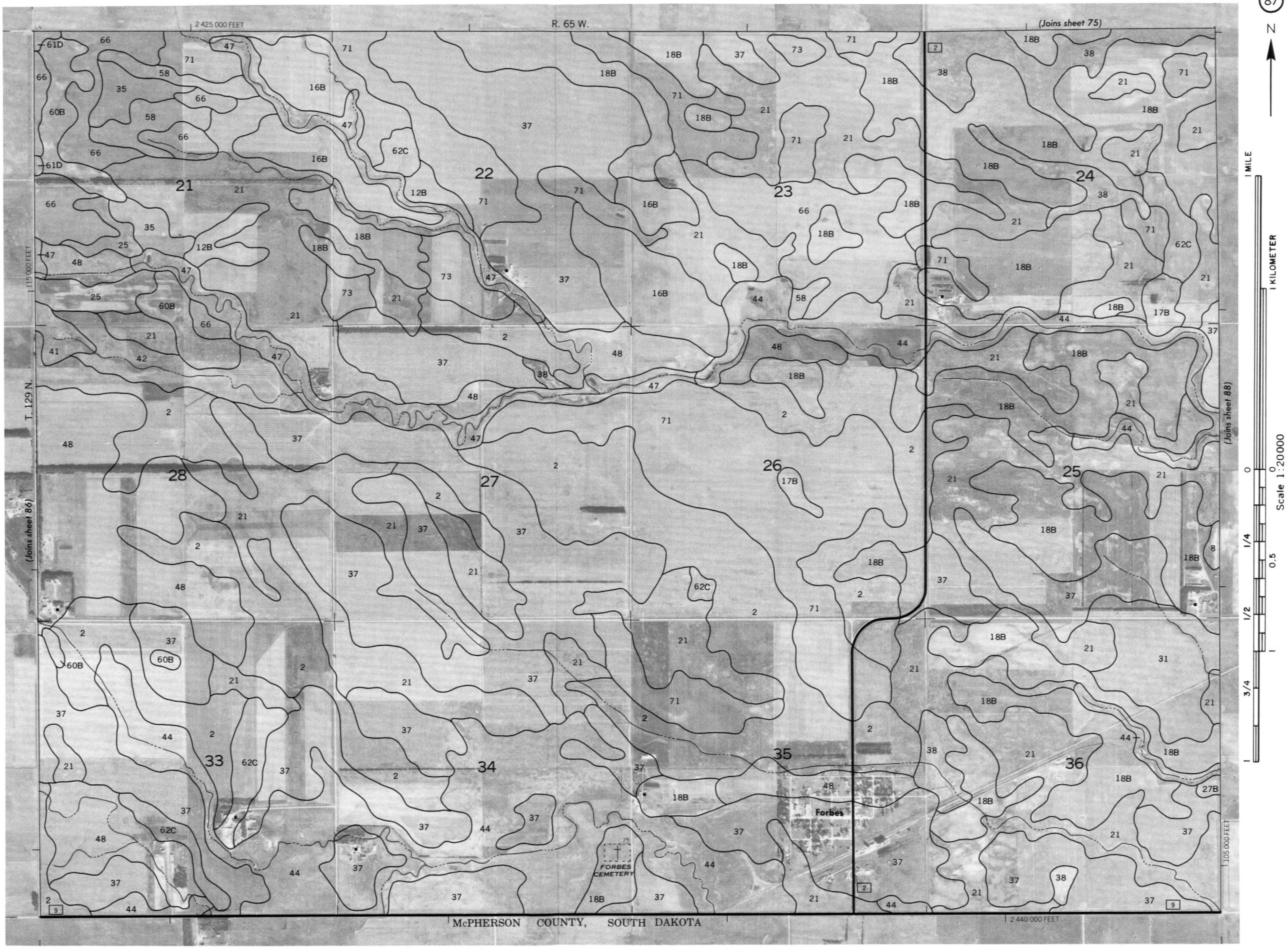
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 85

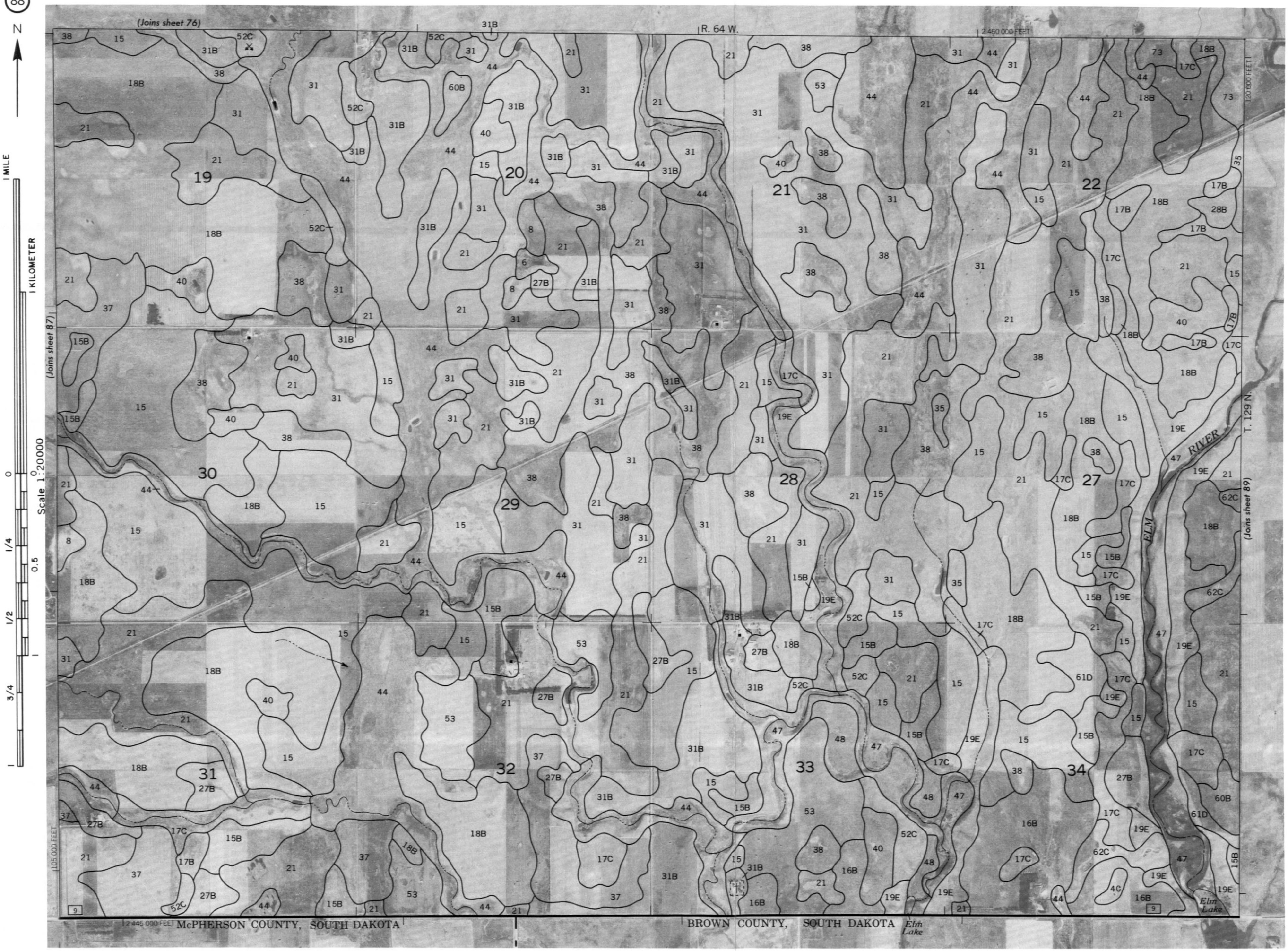


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 86



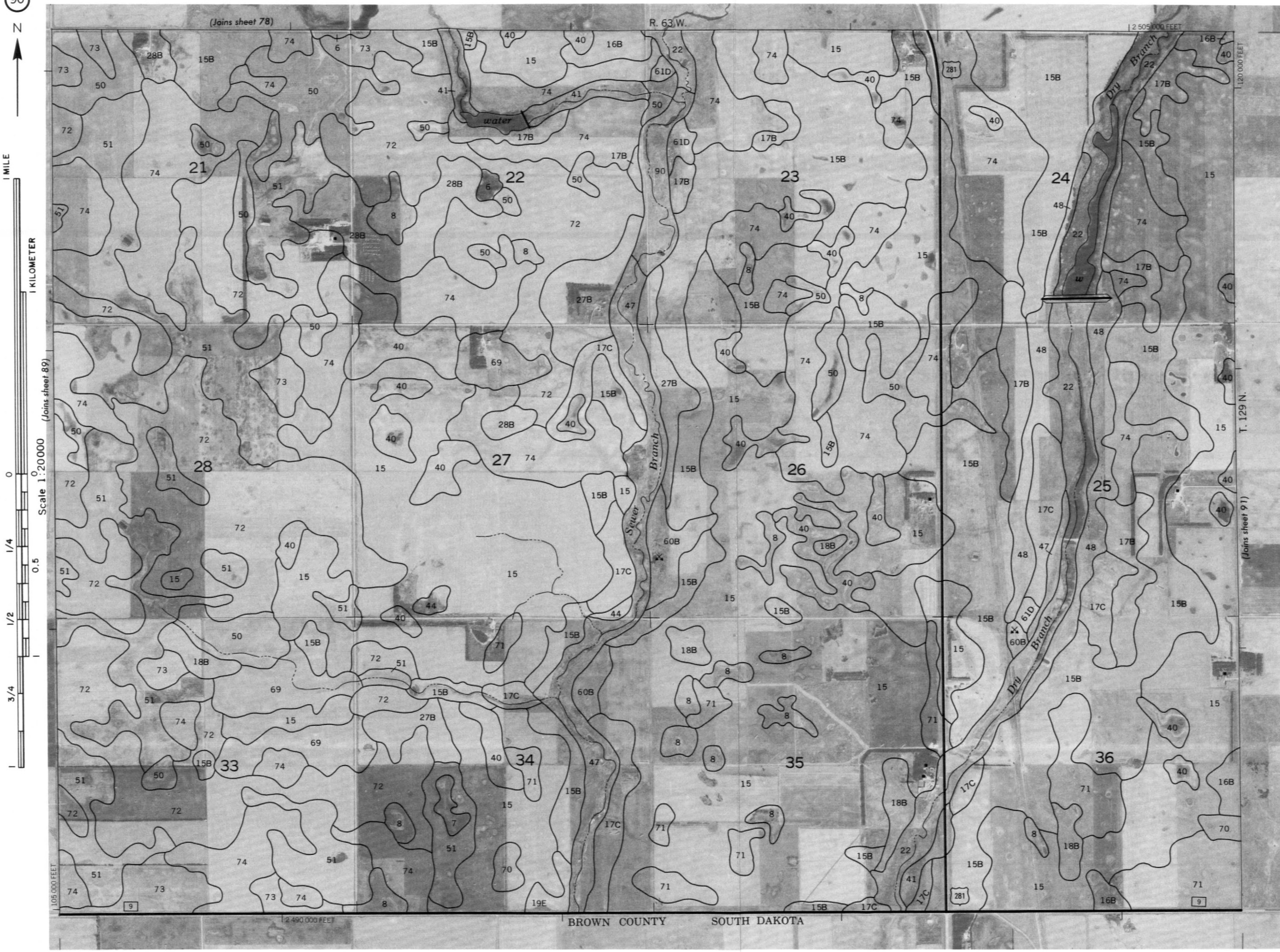
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 87



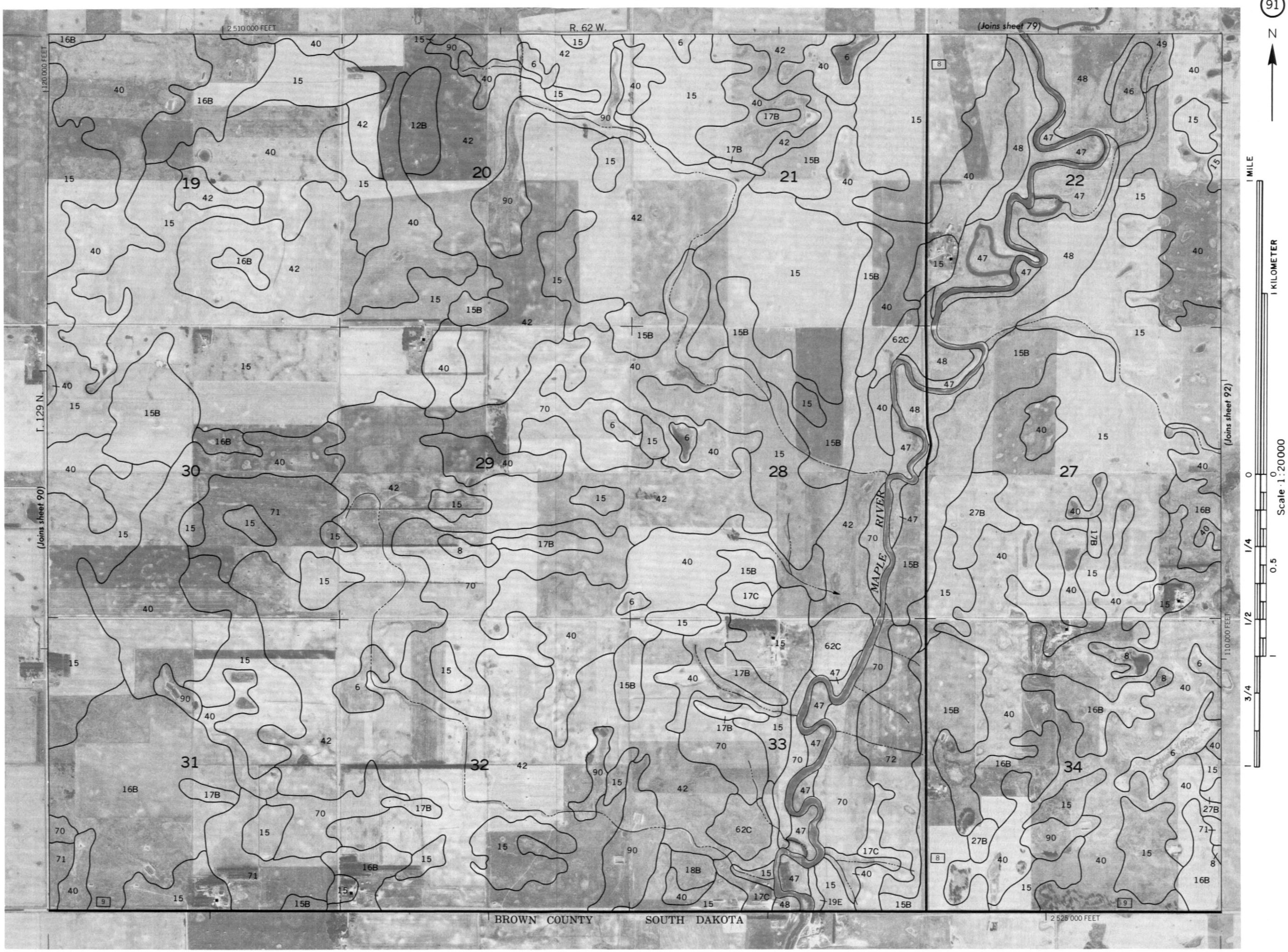

N
1 MILE
1 KILOMETER
Scale 1:20 000
(Joins sheet 76)
(Joins sheet 87)
(Joins sheet 89)
R. 64 W.
T. 129 N.
2 460 000 FEET
120 000 FEET
105 000 FEET
2 445 000 FEET
McPHERSON COUNTY, SOUTH DAKOTA
BROWN COUNTY, SOUTH DAKOTA
ELM RIVER
Elm Lake
19
20
21
22
27
28
29
30
31
32
33
34

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 89

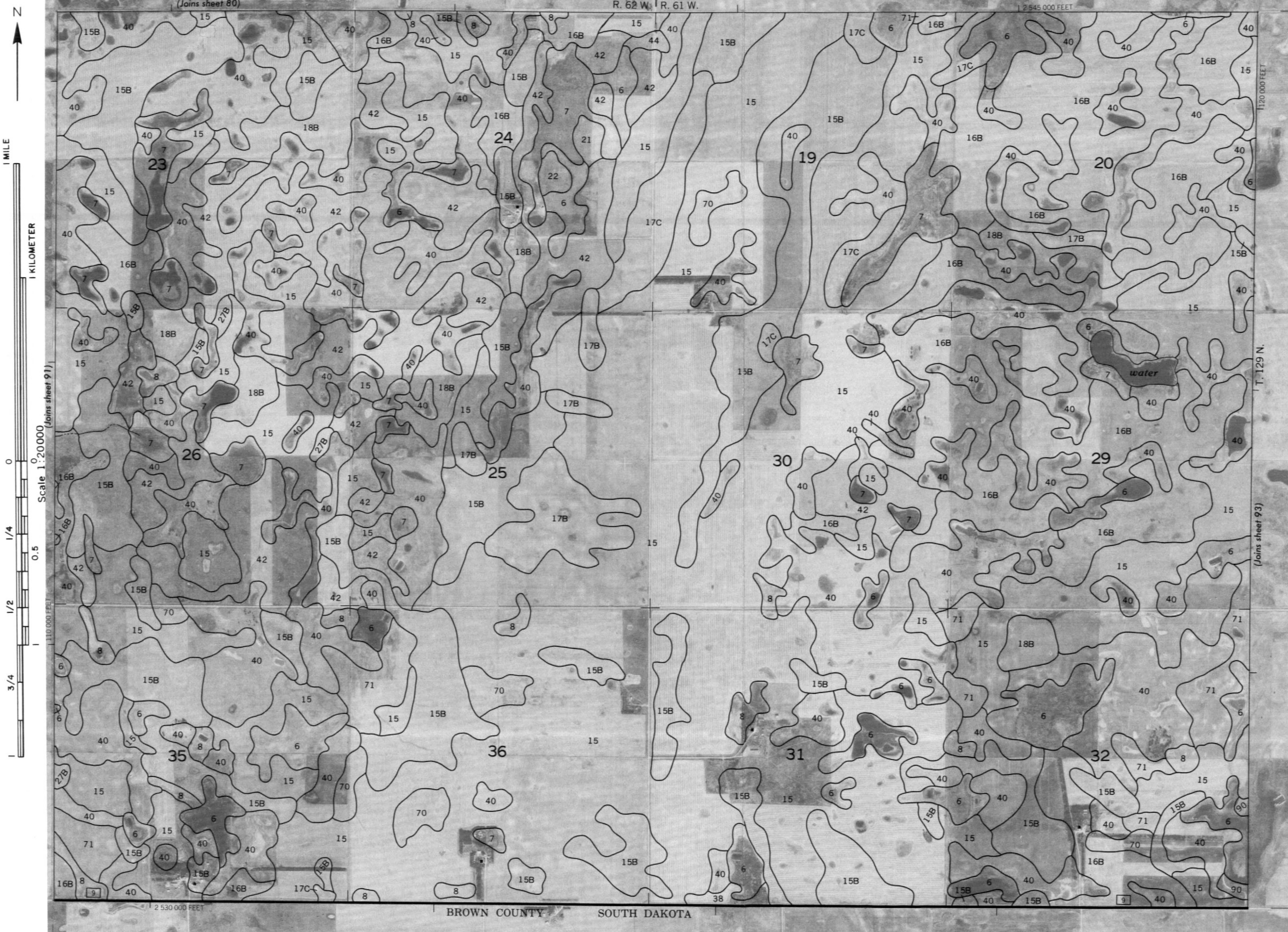
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 90



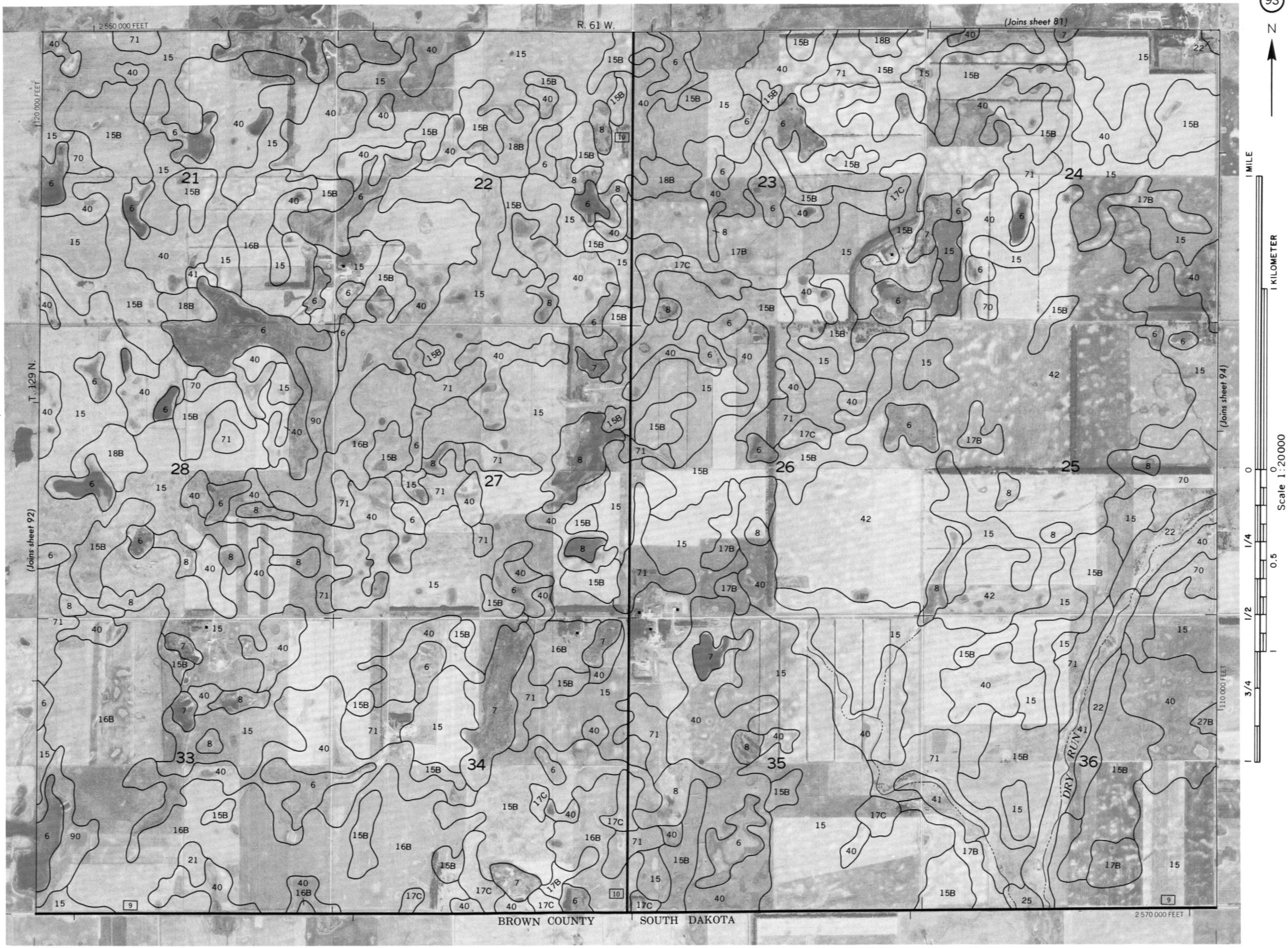
SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 91

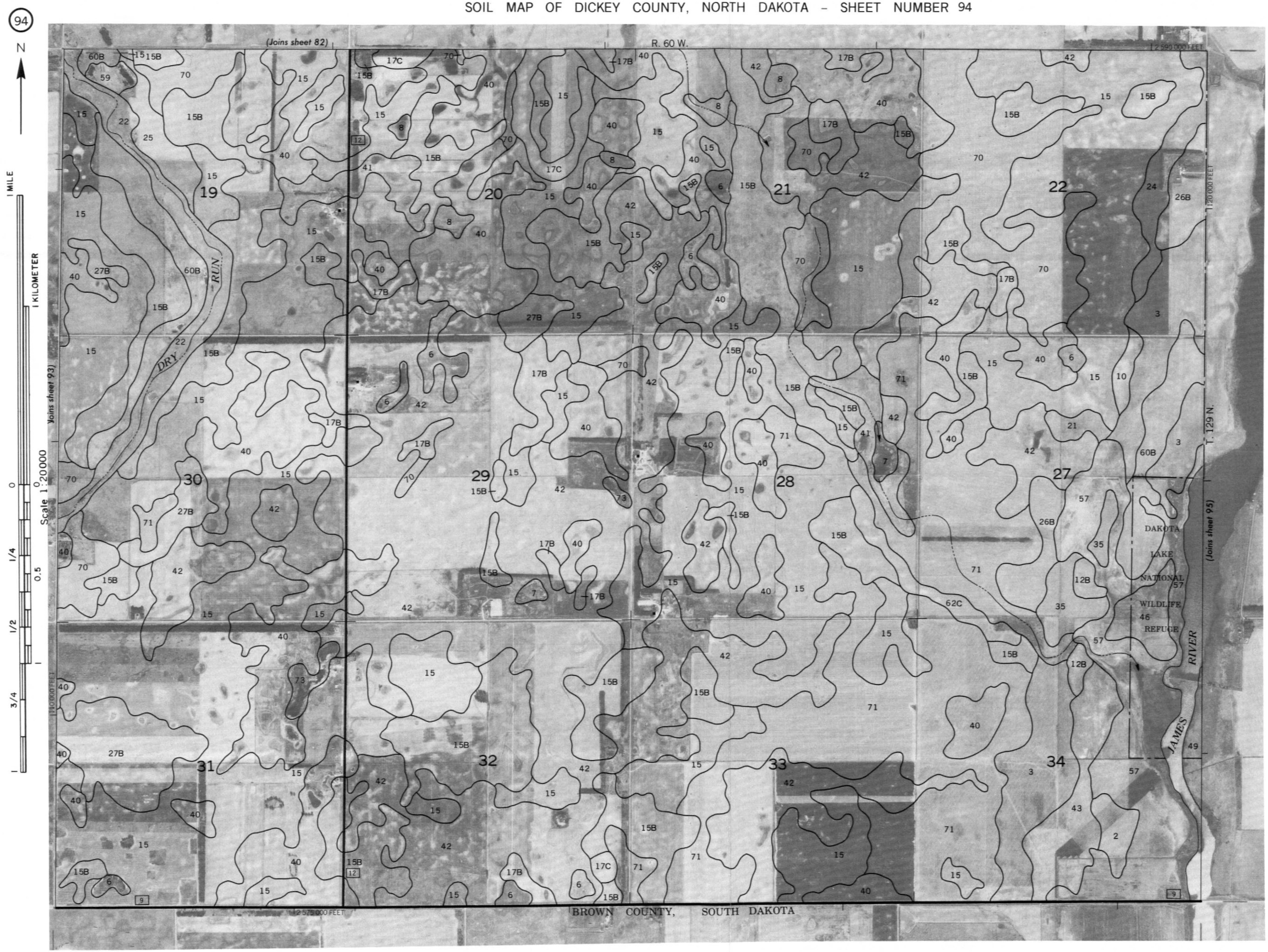


SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA - SHEET NUMBER 92



SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 93




94
N
(Joins sheet 82)
R. 60 W.
2 590 000 FEET
120 000 FEET
(Joins sheet 93)
(Joins sheet 95)
T. 129 N.
DRY RUN
JAMES RIVER
DAKOTA LAKE NATIONAL WILDLIFE REFUGE
BROWN COUNTY, SOUTH DAKOTA
2 575 000 FEET
110 000 FEET
19
20
21
22
30
29
28
27
31
32
33
34
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 95

(96)

SOIL MAP OF DICKEY COUNTY, NORTH DAKOTA – SHEET NUMBER 96